Vertical Linkages in Agri-Food Supply Chains in Canada and the United States

June 2001

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VERTICAL LINKAGES IN AGRI-FOOD SUPPLY CHAINS IN CANADA AND THE UNITED STATES

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Research and Analysis Directorate
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Agriculture and Agri-Food Canada

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Table of contents

Executive summary vii

Introduction 1

Section 1: Introduction 3

Section 2: The nature of vertical linkages 5

Literature Review 7

Section 3: Early work on vertical coordination 9
- 3.1 Interest in Vertical Coordination 9
- 3.2 Vertical Coordination in the 1950s and 1960s 9
- 3.3 Forces for Change 11
- 3.4 Summary 12

Section 4: Recent developments in vertical coordination 15

Section 5: Factors leading to increased vertical coordination 19
- 5.1 Changing Consumer Preferences 19
- 5.2 Biotechnology 21
- 5.3 Information Management 22
- 5.4 Environmental Issues 23
- 5.5 Credit and Risk 23
- 5.6 Trade 23
- 5.7 Summary 24

Section 6: Theoretical approaches to vertical coordination 25
- 6.1 Transaction Cost Economics 25
- 6.2 Agency Theory 27
- 6.3 Competency/Capabilities Approach 28
- 6.4 Strategic Management Theory 30
- 6.5 Convention Theory 33
- 6.6 Synthesis of the Theoretical Literature 33

-1

A Conceptual Framework for Closer Vertical Linkages 37

Section 7: Conceptual framework 39
- 7.1 Mapping the Relationships 39
- 7.2 Transaction Characteristics, Costs and Vertical Coordination 40
- 7.3 Relationships Between Product Characteristics and Transaction Characteristics 42
- 7.4 Regulatory, Technological and Socio-Economic Drivers 43

Section 8: Application of the framework: the case of US corn and soybeans 47
- 8.1 New Grain Products and Closer Supply Chain Relationships 47
- 8.2 Changes in Product and Transaction Characteristics 50
- 8.3 Summary 50

Pricing, Policy and Market Failure Implications 51

Section 9: Price formation and associated issues 53
- 9.1 The Evolution of Agricultural Markets 53
- 9.2 Bulk Commodity Markets 54
- 9.3 Contract Production Pricing and Associated Issues 54
- 9.4 Franchises 58
- 9.5 Monopolistic Competition 59

Section 10: Impact on existing agricultural policy arrangements 61
- 10.1 US Farm Policy 61
- 10.2 Canadian Income Support Policy 62
- 10.3 Marketing Institutions 62

Section 11: What is the appropriate role for government? 65
- 11.1 Public Versus Private R&D 65
- 11.2 Dealing With Information Asymmetry 66
- 11.3 Dealing with Monopoly/Monopsony Power 68
- 11.4 Regulatory Incentives 69

Section 12: Looking into the future 71

Section 13: Conclusions and suggestions for future research 75

Section 14: References 77

List of Figures

Figure 1: Extent of contracting in the 1950s (U.S.) 10
Figure 2: Synthesis of theoretical approaches to vertical coordination 34
Figure 3: Factors affecting vertical coordination: a framework 39

List of Tables

Table 1: Extent of contracting in selected commodities, United States, 1997 15
Table 2: The relationship between product characteristics, drivers and transaction characteristics 41
Table 3: Selected grain products in the United States and Canada 48

Executive summary

The agri-food sectors of both Canada and the United States are experiencing a trend toward closer vertical coordination. New relationships with downstream product handlers and processors raise many questions for producers, including the level and nature of risk they face, control over management practices and access to markets. Public policy implications include the nature of price discovery and whether market failure indicates a revised role for governments in a vertically-linked agricultural sector.

This report describes the nature of vertical linkages in agriculture, ranging from spot markets to vertical integration. It reviews the applied and theoretical literature relating to vertical coordination. It presents a conceptual framework linking changes in the transaction environment and product characteristics to changes in vertical coordination. Finally, the report examines the implications of closer vertical linkages for industry stakeholders and for policy makers.

Vertical coordination encompasses a continuum of possibilities from open spot market transactions, where price is the only mechanism of coordination, to full vertical integration, where managerial orders direct the flow of goods between stages. Contracts, strategic alliances and joint ventures are other means of vertical coordination. Contracting has become increasingly important in Canadian and, in particular, US agriculture.

Interest in vertical coordination can be traced back to the 1950s, when changing technology and the nature of price and production risks were instrumental in driving the US broiler sector toward closer contracting and vertical integration. More recently, the US hog sector has witnessed an increase in the use of contracting. Similar trends are expected in the Canadian hog-pork sector following the removal of single desk selling agencies in several provinces in 1997. Identity preserved supply chains for value-enhanced crops produced on contract are emerging in both countries and co-exist with bulk commodity grain marketing systems. Changing consumer preferences, biotechnology, information technology, environmental pressures, credit and risk issues and the reduction of global trade barriers are some of the driving forces behind changing vertical coordination.

A number of theoretical approaches enhance our understanding of the motivations behind, and the consequences of, closer vertical linkages. These include transaction cost economics (TCE), agency theory, the core competencies approach, strategic management theory and convention theory. These approaches share many overlapping concepts, yet individually also contribute additional pieces to the vertical coordination puzzle. The predictive ability of TCE and agency theory provides a set of behavioural and informational assumptions which are central to the analysis presented here.

This report develops a conceptual framework for examining the forces behind closer vertical relations. The framework has four components: environmental drivers, product characteristics, transaction characteristics and vertical coordination mechanisms. The transaction characteristics affect vertical coordination outcomes through their influence on transaction costs. In addition, product characteristics and environmental drivers (e.g., technological, regulatory, socioeconomic drivers) also affect transaction characteristics. Product characteristics include perishability, product differentiation, quality variability, and the addition of new (credence) characteristics. Transaction characteristics include quality, quantity and price uncertainty for buyer and/or seller, frequency, asset specificity and complexity. The framework is intended as a starting point for analysis, to which additional product characteristics and environmental drivers may be added.

An application of the framework to the US corn and soybean sectors reveals the importance of technological change. Both biotechnology and advanced breeding techniques have produced differentiated, value-enhanced grains, with a potential increase in the costs of measuring quality and greater uncertainty for buyers and sellers over some aspects of the transaction. The transaction costs of occasional supply chain relationships increase, resulting in growth in contracting and identity preserved supply chains.

In the future, agricultural markets and marketing channels are likely to increase in diversity, with a number of different vertical coordination arrangements co-existing to service different market needs. The move toward contract production and away from spot market transactions raises the question of how prices are discovered and whether a thin market problem exists. This issue is not new. Another important question is the extent to which an "average" price is relevant for decision-making given the differentiated nature of production under contract. Questions of relative market power and producers' access to closed supply chains are also important.

On the other hand, potential market efficiencies from closer vertical coordination may improve the relative competitiveness of an industry and result in an outward shift of the demand curve through the ability to tailor product quality to the needs of specific market segments. Transparency of contract terms and a mechanism to resolve disputes between contractual parties are important and may represent a different role for industry associations or governments. The role may include facilitation of collective bargaining processes. Franchise relationships and the branding of agricultural products may present a middle ground for producers.

If closer vertical linkages reduce the cyclical fluctuations in some agricultural markets and defuse the traditional adversarial relationships between producers and processors, there may be a reduced need for traditional commodity-based farm support programs. The future role of regulated marketing institutions in the Canadian agri-food sector depends partly on the extent to which they act as transaction-cost economizing methods of vertical coordination.

What is the appropriate role for governments in an agriculture industry characterized by closer vertical linkages? The answer depends on whether the changing supply chain relationships generate new (or, indeed, nullify old) situations of market failure. Biotechnology has enabled differentiation of bulk commodities, enabling the private sector to reap the rewards of investment in R&D. These rewards are reflected in a reduced public role in R&D, although government policy is important in creating a regulatory environment conducive to investment in R&D.

The traditional price reporting role of governments becomes less feasible, and arguably less important, in a closely coordinated system. However, quality information becomes more important. Highly differentiated agricultural products with credence characteristics suggest a role for governments in reducing information asymmetry through the provision of quality information or accreditation of quality assurance schemes. Alternatively, this may be a role for independent private sector third parties. The potential abuse of monopoly and monopsonistic power on the part of agricultural input suppliers and buyers of agricultural output raises the old spectre of producers being caught in the middle with relatively weak bargaining power. While this remains an important policy consideration, the potential transaction benefits from membership of a differentiated, value-added supply chain should not be ignored. Further, competitions (anti-trust) regulation should consider the economic benefits from vertical coordination.

Looking into the future, advances in electronic communication may "buck the trend" toward closer vertical coordination among producers, processors and retailers by presenting opportunities for producers of specialty goods to deliver directly to the end-user. Electronic communication may benefit agricultural producers by increasing their access to information. This access offers a first-mover advantage to those producers able to manage this information and to find innovative ways to use it. As with any business opportunity, entrepreneurial producers with the requisite business management skills and acumen will succeed in this endeavour.

The changing nature of vertical linkages in the Canadian and US agri-food sector present both opportunities and challenges for industry stakeholders, policy makers and analysts. This topic is dynamic and new research questions are continually emerging as we seek to answer existing ones. By design, this report has taken a broad approach to vertical coordination across the agri-food sector. While there has been a reasonable amount of research focussing on vertical coordination in US agriculture, industry-specific studies of vertical coordination in Canada are few and far between. In the livestock sector, the Canadian beef and pork sectors would benefit from an in-depth study of vertical coordination. In the grains and oilseeds sectors, an analysis of the canola and specialty crops sectors would provide a valuable comparison with the Canadian wheat industry. The role of regulated marketing institutions in facilitating or impeding vertical relationships deserves further attention. The framework presented in this report provides a starting point for analysis.

The lack of basic data describing the nature of vertical relations, including the extent of contracting, in the Canadian agri-food sector seriously impedes the ability of policy makers, industry stakeholders and researchers to monitor and to evaluate developments in the sector. The collection and analysis of primary data on the nature of vertical linkages in the Canadian agri-food sector should be a priority for the federal government.

These recommendations are far from definitive. They are intended to suggest that in upcoming years, producers, downstream processors and retailers, academics, and policy makers will need continually to reshape their thinking about the organization of agricultural supply chains and associated policy issues.

Introduction

Section 1

Introduction

The agri-food sectors of Canada and the United States are moving toward closer vertical coordination. This movement is occurring in varying degrees and forms in different industries and involves a diversity of supply chain partners. Some industries, notably the United States poultry industry, developed close vertical coordination in the 1950s. In other industries, close vertical coordination is a more recent phenomenon.

It is worth revisiting the definition of "vertical coordination" provided by Mighell and Jones (1963) who explain that the term:

> *"...includes all the ways of harmonizing the vertical stages of production and marketing. The market-price system, vertical integration, contracting, and cooperation singly or in combination are some of the alternative means of coordination."* (p. 1)

Within this succinct definition is the notion that vertical coordination encompasses a continuum of possibilities, from open market spot transactions at the one end, through to full vertical integration at the other and including strategic alliances, joint ventures, contracting, etc. In a sense, there is *always* some form of vertical coordination—be it directed by price signals alone in a spot market or by a combination of pre-determined factors in a contractual situation. Where the interest lies for agricultural economists, policy makers and agri-food industries is in the implications of the move toward *closer* vertical coordination—i.e., as a sector moves away from commodity spot markets and toward more closely specified vertical linkages between identifiable partners in the supply chain. This move is a private sector adaptation to a market environment that has changed due to a host of technological, regulatory and financial developments, in addition to changes in consumer preferences (quality, food safety, etc.).

Interest in this topic is motivated by the scope and pace of change of the linkages between members of the supply chain for agricultural goods. For example, new genetically modified crops are having a profound impact on the supply chains for corn, soybeans and canola. Until recently, these crops were marketed almost solely through efficient bulk commodity markets. Now the bulk commodity markets coexist alongside closely coordinated supply chains for identity preserved products. The increase in close vertical coordination arrangements has been rapid and is manifested in a wide variety of forms.

Implications of these new closer vertical linkages for agricultural producers include the nature and level of risk they face, profitability, scope of control over decisions, and management practices. There are implications as well for public policy. In the Canadian grains sector, closer vertical coordination is occurring in special crops, and to some extent, in canola. The Canadian Wheat Board (and associated institutions) is a vertical coordination mechanism implemented through public policy. Currently, there is much debate over whether the Canadian Wheat Board will evolve in response to the pressures for closer vertical coordination in the

wheat supply chain or whether an alternative, private sector system will emerge as a more effective coordination mechanism. A similar debate surrounds the coordinating role of marketing boards in the Canadian agricultural sector.

For some time US public policy has been concerned with the maintenance of a viable mechanism for price discovery in commodities dominated by contractual arrangements, along with the adequate provision of price information. At present, the rapid increase in close vertical coordination for corn and soybeans, and the potential increase in wheat, adds a new dimension to questions about the effectiveness of US commodity programs. US farm policy lacks clear direction. The policies advanced by the 1995 Federal Agricultural Improvement and Reform (FAIR) Act have been confused by ad-hoc assistance to the agricultural sector from the U.S. Congress. Other longstanding concerns for public policy are the potential abuse of market power by members of the supply chain and the bargaining position of family farmers vis-à-vis processors and negotiators.

The ability of supply chains to adapt quickly to new market requirements and to meet stringent quality standards is of concern as governments attempt to find solutions to trade conflicts that arise due to regulations maintained by importers that differ from the country of origin.

Finally, increased vertical coordination raises the question of whether government action is required to facilitate closer vertical relations in agricultural supply chains. The underlying question is whether evidence exists of market failure (such as imperfect information) that would justify government intervention.

This report begins with a description of the nature of vertical linkages (from spot markets to vertical integration). Section 3 reviews the literature on vertical coordination in agriculture. It begins with a review of early work on vertical coordination in order to assess changes in its extent, the policy issues of concern, and the analytical approaches used. A summary of the factors behind vertical coordination and a review of recent developments in agri-food sectors in Sections 4 and 5 set the stage for a discussion of theoretical approaches in Section 6. Sections 7 and 8 present a framework for understanding the factors affecting vertical coordination and apply the model to a case study of the US corn and soybean sectors. Finally, Sections 9, 10 and 11 examine the implications of closer vertical coordination for industry stakeholders and policy makers in terms of price formation and the appropriate role of government policy in correcting marketing failure and facilitating the development of efficient supply chains.

Section 2

The nature of vertical linkages

Vertical coordination includes a continuum of possibilities—from spot market transactions to full vertical integration. The middle ground encompasses various hybrid forms including contracts, strategic alliances and quasi-integration (joint ventures). In spot markets, goods are exchanged between multiple buyers and sellers in the current time period, and price is often the sole determinant of the sale, e.g., auction markets. Vertical coordination occurs entirely in response to price signals. Spot markets are efficient for the distribution of homogenous commodities. However, as agricultural products become more differentiated and buyers prefer more heterogeneous products, there is a need for improved information flow along the supply chain. Thus, methods of vertical coordination which allows closer buyer-seller relationships are emerging, such as contracts, strategic alliances and quasi-vertical integration.

Under a contract, a farm transfers control over certain aspects of production and/or marketing in return for greater surety over access to markets or inputs and lower risk. In 1997, 31 percent of the value of US agricultural production (almost US$60 billion) was grown or sold under contract (Banker and Perry 1999). While US farms of all types use contracting, larger family farms (sales of at least US$250,000) and non family farms (non family corporations or cooperatives and farms run by hired managers) account for 75 percent of the value of products grown and sold under contract.[1]

Following Mighell and Jones (1963), contracts can be classified into three broad groups. Market-specification contracts represent an agreement by a buyer to provide a market for a seller's output. The buyer may assume some risk and the right to make decisions over the timing of marketing. The farmer retains control over production. Production-management contracts entail more buyer control, allowing the buyer to specify and/or to monitor production practices, input usage, etc. Resource-providing contracts represent the greatest level of control for buyers who provide a market outlet, supervise production practices and supply key inputs. In doing so, the buyer usually assumes a greater proportion of the risk and may retain ownership of the product, with the farmer, in effect, being paid a management fee. This type of contract is close to full vertical integration. In 1997, 11 percent of US farms engaged in contracting, with production contracts (2.2 percent of all farms) being less prevalent than marketing-specification contracts (9.2 percent of all farms)[2] (Banker and Perry 1999).

Typically, quasi-vertical integration (a joint venture) is a long-term contractual obligation in which both the buyer and seller have invested resources in the relationship. It differs from full vertical integration because the relationship ceases at the end of an agreed period of time and the firms remain independent entities. An example would be a joint venture in which participants share the costs, risks, profits and losses of a venture. Franchises and licenses are other examples but are not common in the agriculture sector. Section 9 discusses the circumstances under which franchising might become more prevalent in agri-food markets.

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[1] Comparable data for Canada are not available.

[2] Data were obtained from the Economic Research Service, U.S. Department of Agriculture through its Agricultural Resource Management Study (U.S. Department of Agriculture 1997). These data do not distinguish between production-management and resource-producing contracts, terming them both "production contracts."

A strategic alliance is characterized by parties sharing an objective, resulting risks and mutual control over decision making (Amanor-Boadu and Martin 1992). Typically, it is more flexible than a contract and requires that the parties recognize their mutual goals and work together to achieve them. Trust is implicit in a successful strategic alliance. An example might be a strategic alliance between a group of producers who follow specified production practices and a pork processor who receives hogs of a specified quality. The processor may also have a strategic alliance with a food retailer to introduce a high-quality packaged pork product developed jointly and another strategic alliance with a hog breeding firm to introduce specific genetics into the supply chain. In this case, the strategic alliance involves all four parties, spanning the supply chain from producer to retailer (Sporleder 1992).

Full vertical integration occurs when one firm owns two or more stages of the production-processing-distribution process. In the Canadian agri-food sector, food retailers have integrated backward into the wholesaling function, "life-science" companies have integrated backward into genetics and basic R&D companies. In the United States, poultry processors have integrated backward into production (although sometimes the relationship is contractual rather than outright ownership). Of course, forward vertical integration is also possible. Sunterra farms in Alberta, originally a family hog farming enterprise, e.g., integrated forward into hog slaughter and processing and into food retailing, opening specialty delicatessen and catering outlets in Calgary and Edmonton.

[illegible]

There is an extensive literature relating—both directly and indirectly—to vertical coordination in agriculture. Section 3 of this report reviews the earlier applied work directly dealing with vertical coordination in agriculture, beginning in the 1950s and extending to today. Recent literature describing ongoing developments is then summarized, including literature reviewing factors leading to increased vertical coordination (Sections 4 and 5). Then an overview of the key theoretical approaches is presented in Section 6.

Section 3

Early work on vertical coordination

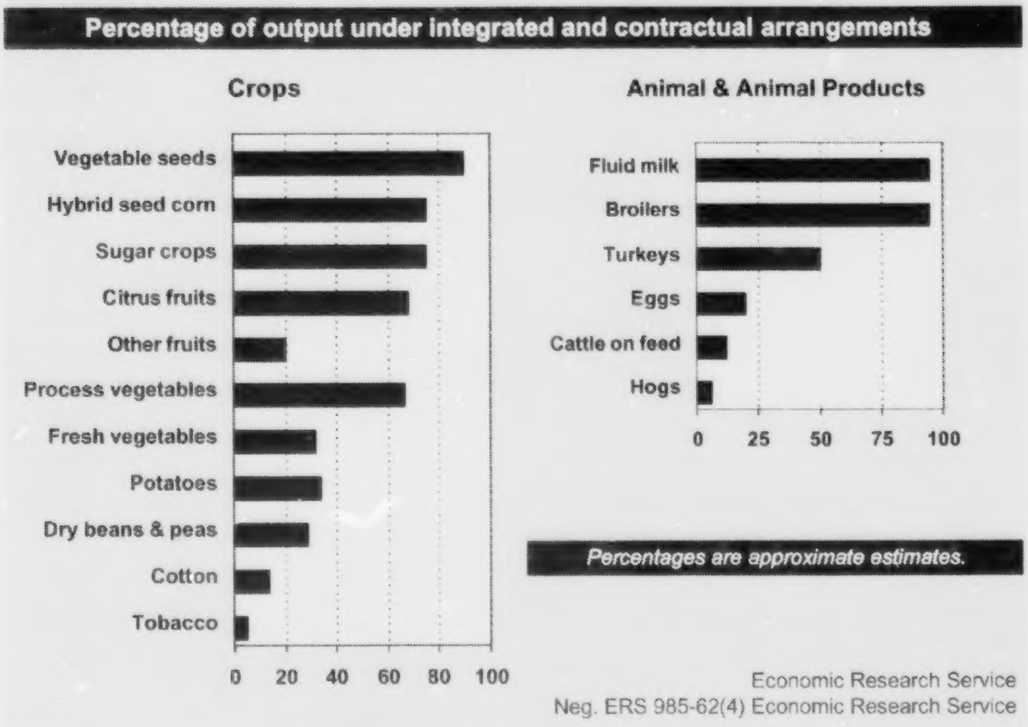
3.1 Interest in Vertical Coordination

In the late 1950s when vertical coordination started to receive the attention of agricultural economists and the U.S. Department of Agriculture, some industries were already characterized by close vertical coordination. Factors behind increasing vertical coordination included the level of risk faced by agricultural producers, changes in technology, and increased needs by farm operations for capital and managerial skills. In this section, early literature is reviewed to identify the types of increased vertical coordination examined in the literature, the forces for change in the 1950s and early 1960s, and the analytical approaches used. After a surge of interest, relatively few articles appeared in 1970s and 1980s. In the 1990s and currently, new analytical approaches coincide with analyses from the agricultural economics, economics, business and management perspectives.

3.2 Vertical Coordination in the 1950s and 1960s

In the 1950s, US industries with a large percentage of integrated and contractual arrangements included fluid milk, sugar crops, processed vegetables, citrus, and some seed crops (see Figure 1). A high degree of coordination existed between the producers and processors of specialty products due to their limited market and an uncompetitive market structure. Perishable commodities, such as fruits and vegetables for processing, had closely managed supply chains since the beginning of those industries. Efficient use of plant capacity and stringent quality requirements for processing are given as reasons for these close vertical relations. The supply chains of major storable commodities, such as corn, wheat, cotton, rice and peanuts, did not develop closer vertical relations at that time because these commodities were durable and amenable to storage. In addition, standardized grading and pricing appeared to be a satisfactory method of communicating quality attributes.

Figure 1. Extent of contracting in the 1950s (U.S.)



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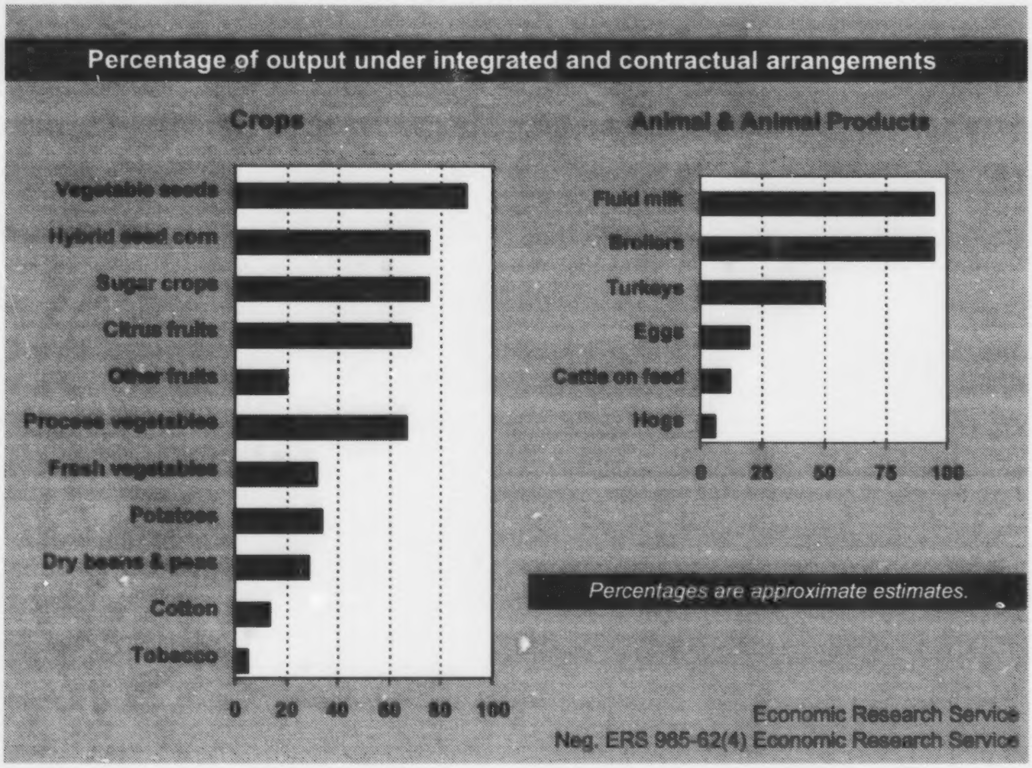
The agricultural economics literature of the 1950s and 1960s often used the terms vertical integration and vertical coordination interchangeably. However, there was general consensus that vertical coordination includes "any type of formal or informal arrangement that has the effect of more closely relating successive steps in the production and/or processing of food and fiber" (Davis 1957, p. 301). In many cases the term did not refer to the coordination of different business enterprises but was used to refer to an extension of the producer's role into marketing the commodity produced.

An early development which increased vertical coordination was the establishment and growth of cooperatives as producers extended their role in marketing (Davis 1957). In the United States, this occurred with the passage of the 1929 Marketing Act, which strengthened the ability of cooperatives to stabilize prices. Marketing orders and agreements were a related attempt to increase producer involvement in, and returns from, marketing their crop. In Canada, provincial legislation providing for group marketing initiatives and the establishment of provincial marketing institutions for agricultural commodities was introduced in a number of provinces initially in the 1930s but was declared unconstitutional by the Supreme Court. Federal enabling legislation, which provided the framework for provinces to set up provincial marketing boards, was finally introduced in 1949. Activities of the U.S. Commodity Credit Corporation associated with farm programs were considered a type of vertical integration due to their impact on market

Figure 1: Extent of contracting in the 1950s (U.S.)



Source: Mighell and Jones, 1963.

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prices (Davis 1957). Contractual arrangements between producers, feed dealers and processors, such as in the United States broiler industry, are also examined in the early literature.

3.3 Forces for Change

New technology and the need for associated human capital, price and production risks faced by producers, and economies of scale are examined as factors contributing to increased vertical coordination. Butz (1958) recognizes that new technology and an associated need for more sophisticated managerial skills contributed to increased vertical coordination. He notes that new technology was accompanied with a commensurate need for increased operating capital. Butz argues that difficulties in transferring a farm operation to a single operator would motivate new forms of farm organization.

Collins (1959) discusses the inadequacy of the price mechanism in conveying information about a broad range of characteristics. It is costly to report many quality characteristics of a single good with associated prices. In contrast, direct contracting avoids miscommunication by specifying to the producer the characteristics desired by the buyer.

Kolb (1959) discusses research on the broiler industry, relating characteristics of family farms to their degree of integration. A survey of highly integrated broiler producers in Ohio and more independent broiler producers in Maine found less difference in objective farm characteristics than in the value operators placed on independence and security.

Jones and Mighell (1961) observe that an increase in close vertical coordination, e.g., with the use of contracts, is associated with an infusion of new technology and managerial skills into the farm operation. Resulting production techniques are likely to reduce production risk, and improve access to credit, as both the bank and the producer are more willing to invest in the farm operation. Jones and Mighell note that feed and fertilizer firms, hatcheries, canneries and other processors furnish capital to producers, while usually retaining ownership. They debate the extent to which contract farming results from imperfections in the capital market.

In a later work, Mighell and Jones (1963) provide an exhaustive treatment of vertical coordination in a U.S. Department of Agriculture Bulletin. Using a static partial equilibrium framework, they analyze how the optimum level of integration is influenced by the cost curves associated with different technologies. They conclude that the firm with the largest scale of operations will realize economies from integration, and hence, is likely to become the integrator.

In the same paper, Mighell and Jones hypothesize that the increase in contract production in the broiler industry was a response to the high degree of risk and uncertainty faced by producers. Sources of risk are wide fluctuations in weekly price quotes and high levels of disease and mortality in birds. The integrator, drawing on production from a large number of producers, would expect small losses with some certainty but did not face the level of risk of independent producers. Developments in feeding technology also motivated feed dealers to have greater control over production. They propose a typology of contracts that continues to be used: market-specification, production-management and resource-providing contracts.

Araji (1976) discusses previous studies of cow-calf operations integrated with meat packers. Integrated operations reduced costs due to lower expenditures on transportation and selling commissions, as well

as reduced shrinkage and death loss. He did not find improvements in internal efficiency due to integration.

A study by the Organisation for Economic Cooperation and Development (OECD) (1978) evaluates changes in the supply chain for beef in member countries. Improvements in the cold chain distribution system involving refrigeration techniques affected supply chain relationships since shipping boxed beef is more efficient than shipping carcasses. The study notes the decline of wholesale meat markets as producers sell to plants that perform slaughtering, processing and packing. In the United States and Canada, packers act as a middleman between producers and retailers. The study recommends that public policy move from a production orientation toward a recognition of the importance of the whole chain. Increased efficiency and transparency of the chain and a balance of power between chain members are cited as key public policy concerns.

Hayenga and Schrader (1980) discuss formula pricing which occurs frequently between closely coordinated firms. Formula pricing contracts use a formula and a specific price quotation to determine prices for individual shipments. Formula pricing decreases the percentage of the supply chain that determines open market prices, potentially creating a thin market problem. Benefits of formula pricing include assured market outlets (particularly for unique products), continuous grower-seller relationships and a reduced risk of forward arrangements being unfavourably compared to prices at the time of delivery. The absence of a well-accepted and accurate price is stated by industry members as one concern regarding formula pricing schemes. Hayenga and Schrader discuss how the success of formula pricing, paradoxically, may destroy the market that provides the base price. They note that formula pricing works well in the cheese industry due to the existence of the National Cheese Exchange, where all industry participants are present, and distortions are quickly communicated and corrected.

Kilmer (1986) evaluates the increase in forward and backward integration in agriculture. He predicts that vertical integration will continue to increase gradually in crops, particularly for vegetables, citrus and other fruits, and tree nuts. Motivations for increased vertical integration include perishability, capital intensity, and discontent among farmers over prices. Kilmer predicts that the extent of vertical integration in corn, soybeans and wheat in the United States is unlikely to change as the current exchange mechanism works well. He argues that the livestock industry has a great deal of potential for vertical integration due to increasing concentration in slaughter plants and feed-lot industries and the need for a continuous flow through slaughter plants. He lists seven factors as determinants of vertical integration: concentration, capital intensity, flow economies, number of inputs and outputs per firm, economies of scope, firm size and future demand.

3.4 Summary

Early applied work in vertical coordination discussed some issues still of concern today. Several authors discussed the trade-offs between the reduced level of risk faced by producers and the decrease in the level of control they have over all aspects of the farm operation. Authors also noted that many farms were too small and under capitalized to be competitive. Closer vertical coordination was often accompanied by significant changes in farm operations, such as an infusion of new technology, capital and managerial skills. Little attention was given to the problem of thin markets and inadequate price discovery in the literature surveyed until Hayenga and Schrader raised these issues in their 1980 article. The impact of vertical coordination or integration on market advantage (market power) was discussed. However, most vertically integrated agricultural businesses were quite small compared to the total market, and economists largely dismissed concerns of market power at the retail level. Some authors, including Butz and Mighell, made a prediction that has been born out, that great political pressure would be brought to bear to stymy the evolution of the independent family operator to a contract-based wage labourer despite the inevitability of the trend toward contract farming.

Other issues, such as the use of close vertical coordination as a means to control the supply of agricultural commodities, have faded (Dawson 1959). The interaction of vertical supply chain relationships and US farm programs was not an important theme as the commodities where close coordination was prevalent did not tend to be included in farm programs.

The motivations for, and implications of, close vertical coordination were addressed largely within neoclassical economic theory. In contrast to later analysis, the role of information and of consumer demand are notably absent. Analysis was largely qualitative and included some partial equilibrium graphical analysis. While some interesting hypotheses were advanced, most of this work was in a period that predates the extensive use of regression analysis to test hypotheses. This work also predates the use of transactions cost economics and other new institutional economic approaches, and there was little discussion of a variety of forms of vertical coordination and why one would be chosen over another. Nonetheless, these early papers raised key questions, including how coordination affects the efficiency of the operation, what enterprise is the driving force in closer coordination and how the scale of operation is determined.

Section 4

Recent developments in vertical coordination

Although there was a flurry of interest in vertical coordination during the 1950s and 1960s, interest faded. Vertical coordination became a renewed subject of investigation by agricultural economists in the 1990s and currently, as a trend toward closer (i.e., more formal) vertical coordination emerges. This section explores the nature of these changes and Section 5 discusses their origin.

One of the challenges for researchers is the scarcity of data available on the extent of different types of vertical coordination. Table 1 presents data on the extent of contracting across commodities in the United States.[3] Unfortunately, the data do not differentiate between production-management and resource-providing contracts and it appears that this estimate for "production contracts" includes both. Production contracts currently are more common for some types of livestock. Almost all contracting in the poultry sector is through production contracts and accounts for 68 percent of the value of production. For hogs, production contracts are dominant and account for 33 percent of the value of production. A smaller percentage of the value of cattle production is under contract and there is a balance between production and marketing contracts.

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[3] To the authors' knowledge, comparable data for Canada are not available.

Table 1: Extent of contracting in selected commodities, United States, 1997

	Value of production under contract				
	Total (million $US)	Total (percent)	In production contracts (percent)	In marketing contracts (percent)	Farms with contracts (percent)
Wheat	448	5.5	0.1	5.4	7.1
Barley	182	19.3	a	10.3	7.3
Soybeans	1,616	10.6	a	10.2	14.0
Corn	1,674	8.9	0.2[b]	8.7	12.1
Potatoes	694	41.5	a	36.7	25.7
Poultry	8,537	70.6	68.3	a	66.7
Hogs	3,271	36.1	32.9	a	11.6
Cattle	8,870	28.4	17.5	10.9	2.1

a: Data insufficient for disclosure.

b: The relative standard error of the estimate exceeds 25 percent, but no more than 50 percent.

Note: Totals are not US totals as they exclude low resource, residential and retirement farms. See Banker and Perry (1999) for a detailed classification.

Source: U.S. Department of Agriculture, Economic Research Service, 1997 Agricultural Resource Management Study.

Section 4

Recent developments in vertical coordination

Although there was a flurry of interest in vertical coordination during the 1950s and 1960s, interest faded. Vertical coordination became a renewed subject of investigation by agricultural economists in the 1990s and currently, as a trend toward closer (i.e., more formal) vertical coordination emerges. This section explores the nature of these changes and Section 5 discusses their origin.

One of the challenges for researchers is the scarcity of data available on the extent of different types of vertical coordination. Table 1 presents data on the extent of contracting across commodities in the United States.[3] Unfortunately, the data do not differentiate between production-management and resource-providing contracts and it appears that this estimate for "production contracts" includes both. Production contracts currently are more common for some types of livestock. Almost all contracting in the poultry sector is through production contracts and accounts for 68 percent of the value of production. For hogs, production contracts are dominant and account for 33 percent of the value of production. A smaller percentage of the value of cattle production is under contract and there is a balance between production and marketing contracts.

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	Total (million $US)	Total (percent)	In production contracts (percent)	In marketing contracts (percent)	Farms with contracts (percent)
Wheat	448	5.5	0.1	5.4	7.1
Barley	162	19.3	a	19.3	7.3
Soybeans	1,616	10.6	a	10.2	14.0
Corn	1,674	8.9	0.2[b]	8.7	12.1
Potatoes	694	41.5	a	36.7	25.7
Poultry	8,937	70.0	68.3	a	66.7
Hogs	3,271	36.1	32.9	a	11.6
Cattle	6,876	28.4	17.5	10.9	2.1

a: Data insufficient for disclosure.
b: The relative standard error of the estimate exceeds 25 percent, but no more than 50 percent.
Note: Totals are not US totals as they exclude low resource, residential and retirement farms. See Banker and Perry (1999) for a detailed classification.

Source: U.S. Department of Agriculture, Economic Research Service, 1997 Agricultural Resource Management Study.

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[3] To the authors' knowledge, comparable data for Canada are not available.

-1 +7

Relative to livestock, a small percentage of grain is grown or sold under contract in the United States. Malting barley is the exception, with maltsters accounting for the relatively high percentage of barley under marketing contracts. However, for soybeans (10.6 percent), corn (8.9 percent) and wheat (5.5 percent), a small percentage of the value of production is accounted for by contracts. The situation is changing quickly for soybeans and corn, however, due to recent developments in the supply chain for these commodities, as discussed in Section 8.

In the United States, there were changes in the poultry and hog industries as transactions shifted from spot markets to production and marketing contracts between farmers and first stage buyers. The share (volume) of broilers produced under contract in the United States stood at about 90 percent in the 1990s, with contracting also important for turkeys, eggs, sugar beets and fruits and vegetables—e.g., chipping potatoes, apples, tomatoes, pickles (Sheldon 1996; Tsoulouhas and Vukina 1999).

The US hog industry has received a lot of attention recently due to its rapid move toward contract production during the 1990s. Rhodes (1995) traces the beginning of "industrialization" in the US hog industry back to the 1970s when larger indoor production units began to emerge. This change in production technology paved the way for closer vertical linkages along the supply chain. By 1997 the largest hog farms marketing over 50,000 hogs a year accounted for 37 percent of US production but only one percent of hog farms. These figures contrast to the situation in 1988 when the largest producers accounted for only seven percent of production. Clearly, the change has been relatively rapid (Drabenstott 1998).

Although analogies have been drawn between developments in the US hog industry and the earlier move toward contracting and vertical integration in the US poultry industry, several commentators observe that developments in the hog industry are different. In the broiler industry the integrator was often another party in the supply chain, such as a feed supplier integrating forward or a processor integrating backward into production. However, until recently this was not generally the case with hogs. Contracting in the US hog industry was most prevalent horizontally among large producers using contract production to increase their production levels (Rhodes 1995). Typically, hog producers finishing feeder pigs provide the capital and labour inputs, while the contractors provide the young pigs, feed, medical services and managerial advice. In a few cases, larger producers integrated forward into packing and backward into feed supply. Drabenstott (1998) points to Premium Standard Farms and Smithfield Foods as examples of vertically integrated pork supply chains from genetics through to final packaging.

Rhodes (1995) conducted a survey of the 57 largest US producers in 1993 and found that about one third of their hog marketings were from vertically integrated producers. A greater proportion of their hog marketings (58 percent), however, were from horizontally contracted production, i.e., not with packers or feed companies. Estimates of the extent of hog production transacted through production or marketing contracts with packers differ. Rhodes states that, in 1993, less than five percent of national production was from operations involved in vertical integration, contract production or joint ventures with packers or commercial feed companies. Whereas, Martinez (1998) reports that 11-13 percent of hog sales to packers were coordinated by contracts and through integrated operations in 1993, rising to an estimated 29-34 percent by 1998. This estimate is based on packer expectations in a 1994 survey.[4] In fact, it appears that contracting has increased at a much faster rate than estimated previously by the packers. Martinez (1999a) estimates that in January 1999, 56 percent of US hog marketings were coordinated through contracts and about two percent through vertical integration. Martinez (1998) confirms that the large producers tend to be the (horizontal) integrator and that, for the most part, hog production operations and packers remain separate entities.

Marketing contracts or agreements increasingly characterize the packer-large producer transaction, with price usually based on the prevailing spot price adjusted for quality. The US hog industry underwent a major structural change in 1999 with the purchase of the three largest US hog producers by Smithfield Foods. The company will control an estimated 10–15 percent of US hog production (Agri marketing 1999). In general, spot market transactions rapidly have become less important, replaced by formal long-term marketing and production contracts or strategic alliances.

The close contractual linkages observed in the US hog industry are not as prevalent in Canada, partly as a result of the institutional structure previously in place. Mandatory provincial marketing boards acted as single desk selling agencies for hogs but did not exercise supply controls. Prices were established on the basis of formulas negotiated between producer marketing agencies and processors. This institutional arrangement inhibited closer vertical relations between producers and packers. In 1997, the hog marketing boards in Alberta, Manitoba and Saskatchewan relinquished their exclusive rights to market hogs produced in their provinces. This change in the mandate of the marketing boards opened the way for closer packer-producer contractual relationships.

Neither the Canadian nor the US beef industries have so far experienced a move toward closely coordinated contractual systems or alliances on a large scale. Pierce and Kalaitzandonakes (1998), however, report the emergence of hybrid forms of vertical coordination in the US beef industry. These can best be described as "value chain" relationships between specific partners in the supply chain. In some cases they involve a producer cooperative forming an alliance with packing and processing firms for the supply of identity preserved, branded beef. A system of premiums and discounts for pre-determined quality attributes and the provision of detailed individual carcass feedback to producers are typical features of these systems. This information gives the system an important informational (and ideally, quality) advantage over traditional beef marketing systems. A mixture of vertical coordination arrangements feature in the Farmland Supreme Beef Alliance described by Kalaitzandonakes and Pierce. These range from vertical integration, whereby Farmland Industries (the largest regional cooperative in the United States) has a major ownership share of the packing firm, to looser downstream relationships with the suppliers of finished cattle, including informal contracts and preferred trading agreements. These types of vertical linkages remain atypical in the Canadian and US beef industries.

The grain marketing system in both countries remains predominantly a commodity-based system; however, other supply chain structures are emerging for some crops. Given the uncertainty of selling specialty crops (e.g., mustard, lentils, flax, etc.) into a spot market, contracts are often used to coordinate the mar-

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[4] The apparent discrepancy in numbers could be explained if Rhodes excludes marketing contracts from his estimates. Lawrence et al. (1997), from a survey of major packers representing 86.5 percent of US slaughter, found that in 1993 just 2.3 percent of the packers' hogs were obtained through production contracts or vertical integration.

keting of these crops in Canada (Weleschuk and Kerr 1995). Identity preserved supply chains are also emerging. Kennett et al. (1998) describe the relationship between Warburtons (a UK bakery company), Manitoba Pool Elevators (now Agricore) and a selected group of Canadian growers to supply Warburtons with wheat exhibiting specific baking characteristics.

Agricultural life-science companies are creating networks incorporating firms at various stages of the supply chain, from R&D to food firms, and involving a range of coordinating mechanisms including vertical integration, strategic alliances and joint ventures (Thompson and Bonderud 1999). The apparent consumer backlash against genetically modified organisms (GMO) in Europe may speed the development of identity preserved supply chains, ironically, to preserve the identity of non-GMO crops. This separation of GMO and non-GMO crops cannot be done through commodity-based spot market transactions (Hobbs and Plunkett 1999). The need for more information about the origin and production characteristics of grain products requires closer vertical linkages between producer, processor and distributor.

To summarize, there has been a steady growth in vertical linkages in many agri-food industries in the United States and Canada. These developments are by no means symmetrical across all sectors or between the two countries. The US hog industry has moved rapidly toward horizontal contracting and more recently toward the use of vertical strategic alliances, marketing or production contracts and vertical integration. The Canadian hog industry has been slower to move in this direction. Examples are emerging of vertical alliances between packers and producers (and sometimes also retailers) in the beef industries of both the United States and Canada and of identity preserved systems for selected grains.

Data on the extent of contracting in the United States for various commodities, by the type of contract, illustrates the uneven use of contracting between sectors (Table 1). Data by the type of operation in the United States are provided in Banker and Perry (1999). To our knowledge, equivalent data are not available for the Canadian agri-food sector. However, even where summary data are available for the United States, they cannot capture the rich variety of vertical coordination arrangements used or the nature of their evolution.

Data on products transacted through strategic alliances, through quasi and fully vertically integrated firms are not generally available. In some cases, the data are not available in a form which allows us to distinguish between complex production contracts and other forms of close vertical coordination. In other cases, the information is proprietary which presents a challenge for analysis and for regulatory oversight of vertically-related markets, as discussed in Section 11.

Section 5

Factors leading to increased vertical coordination

In this section, we explore the factors behind increased vertical coordination and summarize the literature dealing with these factors. The market environment is evolving rapidly due to changes in consumer demands, government regulation and advances in technology. To succeed, firms adjust the level and mechanisms of vertical coordination with their upstream or downstream supply chain partners.

5.1 Changing Consumer Preferences

Consumer demand for food quality and diversity has been a pivotal factor in increasing vertical coordination in the food industry. Kinsey (1997) notes that:

> *"Postmodern consumers make a life project out of creating and displaying their individual sense of style through... the foods they eat... Their endless pursuit of new experiences and distinguishing tastes creates a market climate where product differentiation and fragmentation flourish." (p. 35)*

Kinsey (1997) and Connor and Shiek (1997) identify the underlying demographic changes that contribute to changes in consumer preferences, including the increase in women working outside the household, longer hours for both men and women in the workplace and smaller households. These factors caused an increase in the number of convenience foods. Growth in the number and importance of ethnic groups desiring food unique to their culture also contributed to an increase in the number of food products. Consumers now have a wealth of information available on the relationship between food and health, and demand a wide range of products that are fresh, low fat, low salt or with some other desirable health characteristic. All of these factors increase the demand for a diverse selection of food products, which is illustrated by the data presented by Connor and Shiek (1997) and Henderson (1998) on new product introductions.

In recent years, food safety concerns, including both incidents of food-borne illness and assessment of the safety of specific food production and processing methods, have become increasingly important to consumers. As incomes increase, consumers are willing to pay more for food safety standards to minimize risk. At the same time, modern consumption habits, ready-to-cook and convenience foods have made consumers more dependent on public authorities for food safety than in traditional societies (Bureau et al. 1999). Incidents of bovine spongiform encephalopathy (BSE), *E. coli*, *Salmonella*, and *Listeria* in both Europe and North America have heightened consumer concern over the safety of the food supply. These consumer concerns motivated the adoption of new food safety regulations by governments. For example, in the United Kingdom, companies are legally required to exercise due diligence in assuring the safety of the products that they sell (Hobbs and Kerr 1992).

Public concern over numerous outbreaks of food-borne illness has prompted voluntary actions on the part of many industries. Quick identification and isolation of the member of the supply chain responsible for the outbreak is recognized as critical by both industry and government. For example, the beef industry in Canada is working toward traceability of individual animals through the supply chain (Hobbs and Kerr 1998). Many industries developed food safety standards and undertook the administration of those standards, requiring close industry coordination. An example is the British Meat Manufacturers Association, whose comprehensive hygiene and manufacturing standards are more stringent than public standards (Bureau et al. 1999).

Food safety concerns extend beyond foodborne illness. The use of irradiation in food processing, the use of bovine growth hormones in milk production, and the production of genetically modified foods concern consumers and have motivated public debate.

Some consumers have ethical concerns about how domestic and imported food is produced. Specific concerns include the impact of production processes on the environment, the use of child labour, and animal welfare. Concerns over animal welfare are most prevalent in Europe. These concerns have resulted in regulations requiring the use of natural conditions for birds and other animals, banning of battery cages, abolition of tethering for sows and reduction or elimination of crates for veal (Gordon 1998). These issues have implications for supply chain relationships as retailers seek to provide consumers with animal welfare assurances when selling meat products. To provide information about on-farm production practices, producers, processors and retailers must communicate through closer vertical relations (Hobbs 1996a).

The increase in demand for quality led to the introduction of quality metasystems for food production and processing (Caswell et al. 1998). While the authors do not provide us with a definition of a "metasystem," the word meta means a more organized or specialized form, therefore a more specialized form of a quality management system. The authors do however, provide a definition of quality management as:

> *"all activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system." (p. 556)*

The maintenance of quality metasystems requires close relations between the members of a supply chain. Caswell et al. propose three categories of quality systems: government mandated, voluntary and quasi-voluntary. The authors note that government mandated systems may lead firms to recognize the advantages of quality control and motivate them to adopt additional voluntary systems. Different types of systems are used to achieve different goals. Goals frequently motivating the adoption of quality metasystems include producing a product with a high and consistent level of quality, environmental management, worker empowerment and customer feedback.

Labelling is one mechanism used to convey information to consumers about the visible (search) and invisible (experience and credence) quality attributes of a good. Caswell (1998) discusses how labelling of safety and process attributes affects markets for food. She notes that consumers consider information on process characteristics in their decisions. Producers, processors and retailers may voluntarily chose labelling as a method of conveying this information to consumers, or labelling may be required by government. As with animal welfare assurances, labelling of process attributes requires closer supply chain relationships.

Consumer preferences for quality and process attributes make it critical for the firm to have a stable and assured supply of key ingredients (Henderson 1998). Provision of adequate information to consumers about the inherent quality of the product is achieved in a variety of ways, including branding, product and firm reputation and labelling. Consumer concerns over food safety, coupled with the need to meet quality regulations and the rise of process characteristics as a more important consumer concern, give firms a strong incentive to enhance their knowledge of and control over the supply chain.

5.2 Biotechnology

The emerging importance of biotechnology in agriculture, particularly genetically modified crops, has created identity-preserved supply chains for corn, soybeans and canola which operate along side the traditional bulk supply chains. There are at least three reasons behind the development of new supply chains for genetically modified crops: the need to capture the value invested in genetically modified products, the need to channel their unique characteristics to the source of demand, and the demand by some consumers for non-GMO foods.

Kalaitzandonakes and Maltsbarger (1998) discuss the identity preserved supply chains developed for marketing quality enhanced grains. They discuss the case of high oil corn which has an oil content of six to eight percent instead of the three percent available in traditional corn. Dupont's strategy for high oil corn is to differentiate between the domestic market, where value is captured through premium prices for seed corn, and the export market. Due to their contractual arrangements with Dupont, individual producers are not allowed to export high oil corn. The supply chain for high oil corn is tightly controlled from the producer to the export customer by Dupont and its partners. Quality assessment and control occur throughout the chain. The authors note that identity-preserved crops must create enough value to compensate for the additional operating and transportation costs associated with identity preservation.

Developments in information technology have contributed to the operation of these new supply chains (Hobbs and Young 2000). Producers use a system of contracting available through Optimum Quality Grains on the Internet to gather information on the availability of contracts for the production of high oil corn. An on-line contracting system connects growers with elevators, feeders and processors.

The commercialization of genetically engineered crops has been accompanied by a radical restructuring of the industry. Marks et al. (1999) discuss the significant numbers of mergers and acquisitions between biotechnology, seed and agrochemical and pharmaceutical firms. The life science companies acquired seed companies to access complementary production, distribution and marketing assets, once the seed became the dominant means of delivering the technology.

Phillips (1998) argues that innovation is a driving force behind industrial restructuring. As many innovations are inherently non-rival, firms must structure their operations to capture the rents behind the innovation. Phillips notes that as production technologies become more linked, e.g., with herbicide-tolerant canola, there has been an increase in vertical coordination between seed merchants, chemical operations and farmers. Canola varieties with specific traits such as high euruic acid content or low linoleic oils increase the specificity of the investment made by farmers as these characteristics have value only when sold into a specific market, and only when produced to the specifications of the end user. Processors and farmers

now use contracts to facilitate the production of goods with these trait specific crops and to assure producers of a market that will compensate them for the cost of production.

There is a growing lack of consumer acceptance of foods containing GMOs in North America and particularly in Europe (Hobbs and Plunkett 1999). Many companies have announced that they will not use GMOs in their products. Imports of some goods containing GMOs have been banned. Several governments have announced mandatory labelling requirements for genetically modified foods (GMFs). These developments have resulted in segregated supply chains for genetically modified crops, even when the crops are not output trait enhanced, such as Round-up Ready soybeans. Segregation of GMFs and non-GMFs raises issues of the development of appropriate standards and the liability of members of the supply chain involved in delivering non-GMO products.

Kindinger (1998) discusses the future of biotechnology and agriculture and predicts:

> *"The consumer's quest and demand for quality will drive food processors and manufacturers to form new coalitions that create new systems and higher standards for food safety.... Biotechnology will allow products to be customized for almost any trait." (p. 1)*

In Kindinger's vision of the future, customers will specify the exact characteristics they desire to the processor, who in turn will work with a biotechnology company to produce the seed. Biotechnology has only begun to exert an influence on commercial agriculture in the last few years and already the consequences for relations between firms have been substantial.

5.3 Information Management

Grain companies, who are not a part of closely coordinated biotechnology supply chains, are looking for ways to remain competitive in the rapidly changing structure of the grains industry. Farmland Industries, a U.S. cooperative owned by local producer cooperatives, responded with new approaches to increasing the value of common grains (Ebbertt 1998, Ebbertt 1999). To do this, Farmland Industries has developed an inventory of the grain in its terminal elevators to determine the quality attributes of grains from various geographic locations. Its goal is to source grain from locations based on their quality attributes, segregate the grain throughout their supply chain, and sell it for a premium to customers demanding higher levels of quality or particular quality attributes. In another venture, Farmland Industries, in conjunction with HybriTech, contracted with growers to provide wheat of a higher uniformity and with specific milling properties for end customers. Farmland Industries' approach involves identity preservation and contracting, developing a differentiated product from common grains.

Developments in information technology have played, and will continue to play, a vital role in the development of new supply chains. Prentice (1998) foresees an increasing proportion of transactions for grains occurring directly between producers and processors through communication on the Internet. He predicts that processors will purchase grains with specific quality attributes in this manner. Developments in transportation technology mean that the unit of transaction will be containers, allowing for identity preservation of the grain and delivery direct to the purchaser.

5.4 Environmental Issues

Consumer demand for environmental protection has consequences for firms similar to the increase in demand for food safety. Some firms attempt to differentiate their product by telling consumers that it was produced in an environmentally friendly manner, resulting in a need for the firm to have more information about, or control over, production processes. Firms also need to meet government regulations concerning the environment.

The relationship between industrialized agriculture and the environment is investigated by Martin and Zering (1997). They argue that the large scale of many integrated broiler and hog operations present a greater opportunity for by-product treatment and alternative use of by-products. With the concentration of production into a small area, it is more efficient to process and to use by-products, while in contrast small operations may have buried or disposed of these by-products in violation of environmental regulations. For smaller operations, the high cost of meeting environmental regulations is a motivation for vertical integration. Finally, the authors note that large integrators, with investments in capital and in some cases in branded products, have incentives to avoid the liability associated with environmental damage.

5.5 Credit and Risk

Featherstone and Sherrick (1992) discuss the respective roles of traditional suppliers of credit and financing, and the new role played by integrators for vertically related firms. For hogs produced under resource-providing contracts, producers typically own the buildings and equipment, and the contractor owns the feed and livestock. As individual farmers move into a contracting position they experience major changes in income and balance sheet statements. With closer vertical coordination the nature of risk faced by the producer is altered as well. While production risks remain, the contract removes most price risk for hogs and for inputs. However, the producer now faces new risks, including contract renewal and contractor default on contract terms. The credit capacity of the producer is likely to be enhanced by the increase in financial stability, with an associated decrease in financing costs. Contract production may provide farmers with low equity a greater chance of entering the industry.

5.6 Trade

Trade in agricultural products has also been an important factor in increased vertical coordination in agricultural supply chains. In Canada, exports of consumer-oriented goods account for almost half of total agri-food exports, and have grown significantly in recent years. The composition of US agricultural exports has shifted from bulk commodities to high-value products. In 1976, US exports of bulk commodities were twice the value of high-value products exported. In 1986 they were equal in value and in 1998, high-value products were nearly double the value of exports of bulk commodities. Many foreign markets, notably the Japanese market, desire specific quality attributes that differ from those of North American consumers. For example, Japanese consumers prefer beef with much higher levels of internal marbling (Kerr et al. 1994).

North American firms have developed specific supply chains to meet regulations in foreign markets that differ from Canadian and US regulations. For example, the European Union (EU) banned the use of artificial growth-promoting hormones in beef produced or imported into the EU. To manage this contentious trade

issue between the EU on one side, and Canada and the United States on the other, strict protocols were developed for a supply chain to export non-hormone treated beef to the EU.

Trade in GMFs provides another example. The EU, Japan, Australia and New Zealand have mandatory labelling requirements for GMFs. These requirements are another motivation for the rapid development of closely coordinated supply chains.

5.7 Summary

Members of many agri-food supply chains have moved toward closer vertical coordination for five reasons: to produce and deliver in a timely fashion the quality attributes demanded by the consumer; to communicate these attributes, many of which are invisible, to the consumer; to ensure that members of the supply chain are compensated for the costs involved; to meet regulatory requirements, both health and environmental; and to meet associated concerns about liability.

Closer vertical relations between firms facilitate the flow of information to the producer on four issues: the traits that consumers desire, production processes and new technologies, the amounts to be produced, and the scheduling of production. Close vertical relations also provide information to consumers over the health, safety and process attributes of the good.

Vertical relations are structured to give firms control over production processes and inputs along the supply chain. Control is important for firms who need an input to meet their obligation to the next stage of production. Issues of liability for supply chain members and the motivation to meet health, safety, quality and environmental standards also figure prominently in the need for control.

Closer vertical coordination can help to assure firms that a market will compensate them for the production of a highly differentiated good. Contracts are one way to assure farm operators that their specialized product will be sold to a customer that values its characteristics rather than through the bulk market. Industry structure has changed with the development of vertically integrated life science firms that seek to capture the rents from their investment in innovation.

It appears that the evolution of closer vertical relations in the agri food sector has not yet run it course. Consumer demand will continue to evolve and technology and regulation will find new ways in which to respond to those needs. This suggests that relations between firms will continue to adapt to a rapidly evolving market.

Section 6

Theoretical approaches to vertical coordination

Contributions to our understanding of the factors determining vertical coordination come from a variety of theoretical approaches. Often these approaches are considered in isolation, however their insights may be complementary and, when considered together, enhance our understanding of the factors driving change. Several of the key theoretical approaches are summarized below. What follows is not intended to be a comprehensive survey of this vast literature, rather a summary of the salient features and an assessment of the contribution of these theories to understanding vertical coordination in agri-food sectors.

6.1 Transaction Cost Economics

New institutional economics encompasses a range of related theories based on common concepts such as transaction costs and imperfect information. Transaction cost economics is one branch of new institutional economics, agency theory is another. With the transaction as the focus of analysis (as opposed to the good), transaction cost economics recognizes that transactions do not occur in a frictionless economic vacuum. Costs arise from using the market mechanism when we relax the neoclassical assumption of perfect information. These costs are ex ante information (or search) costs—e.g., seeking and evaluating suppliers or obtaining price information. Ex ante negotiation costs arise in determining the terms of the transaction and there are ex post monitoring and enforcement costs of ensuring that the pre-agreed terms of the transaction are adhered to.

Four key concepts underlie transaction cost economics and distinguish it from the traditional neoclassical theory of the firm: information asymmetry, bounded rationality, opportunism and asset specificity. The assumption of perfect information is relaxed, allowing for information asymmetry between transaction partners. Transaction costs are incurred in reducing the risks parties face as a result of moral hazard and adverse selection.

Transaction cost economics recognizes that individuals exhibit bounded rationality. Although individuals may intend to make a rational decision, their ability to evaluate accurately all possible contingencies is physically limited (Simon 1961). Bounded rationality can increase transaction costs in situations of complexity and uncertainty.

Opportunism ("self-interest seeking with guile" Williamson 1979, p. 234) may be present. Due to information asymmetry and bounded rationality, individuals are not able to determine with certainty whether a transaction partner will act opportunistically. Again, transaction costs are incurred in mitigating this risk which tends to be higher when a "small numbers bargaining problem" exists.

Asset specificity creates transaction costs. These costs arise when one party to a transaction makes an investment in an asset specific to the requirements of another party, with little or no value in

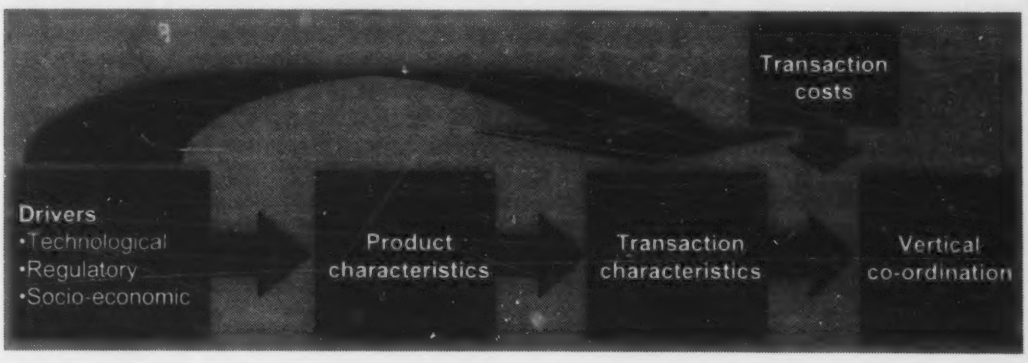
Section 7

Conceptual framework

7.1 Mapping the Relationships

Drawing on the insights provided by transaction cost economics, Figure 3 presents a framework for examining the forces behind closer vertical relations in agri-food supply chains.[9] The framework has the following four components: drivers, product characteristics, transaction characteristics and vertical coordination. Following Williamson (1979), we hypothesize that certain transaction characteristics affect vertical coordination, or the choice of "governance structure." Transaction characteristics affect vertical coordination through their effect on transaction costs as shown in Figure 3. The transaction characteristics also influence the *agency relationship* between firms, thereby affecting the design of governance structures. Furthermore, the extent to which transaction characteristics alter vertical coordination depends on the *core competencies* of the firm, whether new skills are required and whether it is more efficient to source these in-house or through a third party.

Figure 3: Factors affecting vertical coordination: a framework



Williamson (1979) identifies uncertainty, frequency and asset specificity as key transaction characteristics affecting the emergent governance structure. Our approach suggests that these specific transaction characteristics are a result of certain product characteristics which are themselves shaped by regulatory, technological and socio-economic "drivers." The drivers encapsulate the institutional environment which is central to convention theory. In some cases, the drivers can affect transaction characteristics directly by influencing the environment within which those transactions are conducted.

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[9] A discussion of this framework can also be found in Hobbs and Young (2000).

alternative uses. Asset specificity includes site specificity, physical asset specificity, human asset specificity, dedicated assets and brand name capital (Williamson 1989), in addition to time specificity. Having made an asset specific investment, "appropriable specialized quasi rents" are created and a firm is vulnerable to opportunistic behaviour because its transaction partner may try to capture those rents through reneging on a prior contractual agreement (Klein et al. 1978). Information asymmetry and bounded rationality preclude firms from knowing with certainty the probability of opportunistic behaviour. Mitigating the "hold-up" problem created by asset specific investments imposes transaction costs on firms.

In his pioneering work in the field, Williamson (1979) related the characteristics of a transaction (uncertainty, frequency and asset specificity) to the governance structures one might expect to see emerge, from "classical contracting" (spot markets) at one end of the spectrum, to unified governance (vertical integration) at the other. Others later added the complexity of the transaction as an additional dimension. Complex transactions are not left to the spot market but require a closer relationship between buyer and seller to accommodate the complexities.

According to Williamson (1979), a low level of uncertainty lends itself to spot market transactions. When aspects of the transaction are uncertain, spot markets may result in higher information and monitoring costs, consequently closer forms of vertical coordination such as long-term contracts, strategic alliances or full vertical integration are predicted. In the absence of asset specificity, hold-up problems are not important and spot market transactions may suffice. As asset specificity increases, however, we move to more formal vertical coordination alternatives. If only one party makes the asset specific investment, vertical integration is likely, whereas a long-term contract or strategic alliance may prevail if both parties to the transaction have asset specific investments. Finally, both parties will value repeat business when the transaction is carried out frequently and a learning effect is induced. Ceteris paribus, highly frequent transactions will occur in the spot market. As transactions become more infrequent, incentives for opportunistic behaviour and informational asymmetries increase and a more formal relationship emerges between the two parties to economize on transaction costs. However, if asset specificity is high, it may be more efficient for very frequent transactions to be carried out within a vertically integrated firm. Thus, the governance structure outcome is determined by synergistic relationships between transaction characteristics.[5]

Transaction cost economics helps us to understand many of the recent changes in vertical coordination in the agri-food sectors of developed countries. Fundamentally, the approach indicates that, in the presence of information asymmetry, a transaction-cost-economizing form of vertical coordination will emerge. For example, increased consumer demand for the intangible aspects of food products, such as food safety, non-visible quality characteristics, assurances of animal-welfare friendly production practices, use (or non-use) of GMOs, etc. raises the information costs for downstream food firms in identifying suppliers of the products with (or without) these characteristics. Invariably, the production/processing practices of upstream suppliers affect these characteristics, imposing additional ongoing monitoring and enforcement costs on downstream buyers in detecting the presence (or absence) of these characteristics to assure their customers that the product is safe or has the desired traits. Producers or other upstream firms may be required to

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5. See Williamson (1979) for a more complete exposition of these arguments.

make asset specific investments to meet the requirements of specific retailers or processors. The resulting transaction costs, for both upstream seller and downstream buyer, mitigate against the use of spot market transactions and toward closer vertical linkages such as contracts or strategic alliances.

One might ask, following transaction cost economics, why full vertical integration does not occur if the transaction costs of using the market mechanism rise as a result of these information and monitoring costs? Why is it that we see a movement along the spectrum of vertical coordination in the agri-food sector toward long-term contracting and strategic alliances but not all the way to the "extreme" of vertical integration. Arguably, there are other reasons deterring retailers and downstream food firms from integrating backward into food processing and farm production, including managerial diseconomies of scale, risk, capital requirements and regulatory barriers. An example of the latter is anti-corporate farming legislation in some U.S. states including Iowa, Kansas, Minnesota, Nebraska, North Dakota, South Dakota, Oklahoma and Wisconsin (Johnson and Foster 1994).

Instances do exist, however, in which food retailers have vertically integrated backward along the entire supply chain to reduce the transaction costs associated with obtaining a reliable supply of a high quality product. Backward integration characterized the market entry strategy of the fast-food restaurant chain McDonalds into transition economies such as the former Soviet Union because, in the absence of legal and financial institutions to protect their investments, the transaction costs of relying on open market or contractual supply relationships simply were too high.

Herein lies one of the weakness of transaction cost theory; it deals admirably with extremes, whether the transaction will be carried out within a vertically integrated firm or through the market mechanism (the "make or buy" decision). The development of testable assertions regarding the choice between hybrid forms of governance (contracting, strategic alliances, etc.) has been less successful. Furthermore, transaction costs are difficult to measure because they are intangible in nature, although progress is being made in this regard.[6]

6.2 Agency Theory

Agency theory focuses on the contractual relationship between two parties, in which the agent performs tasks for the principal. The optimal contractual relationship will depend on the information, negotiation, monitoring and enforcement costs involved in creating an incentive structure which sends the right signals to the agent. It also depends on the relative degrees of risk aversion between principal and agent. Transaction costs are central to agency theory, as is information asymmetry. The focus of attention is the *terms* of the contractual relationship between the two parties to a greater extent than is the case with transaction cost economics, however, they are related theories.

Agency theory can be separated into two branches—positivist theory and principal-agent theory (Sauvée 1998). Positivist theory (Jensen and Meckling 1986) tends to be descriptive and mainly concerned with the governance mechanisms of contracts, while principal-agent theory (Grossman and Hart 1986) develops quantitative models to solve for the contractual optimum. In either case, the principal can face the risk of adverse selection due to ex ante opportunism which arises from hidden information or faces the risk of moral hazard due to ex post opportunism arising from the hidden actions of agents.

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[6] In the agricultural economics literature, see for example Frank and Henderson (1992); Hobbs (1996a), (1996b) and (1997). For an excellent review of empirical research in transaction cost economics, see Shelanski and Klein (1995).

Essentially, agency theory searches for the optimal contractual relationship between principal and agent which, ceteris paribus, minimizes the sum of transaction costs from monitoring agent's *actual* behaviour and measuring the *outcomes* of agent's behaviour, while transferring risk to the agent. The costs for the principal in obtaining information about agent behaviour and the outcomes of that behaviour depend on two abilities: the ability to observe what work is done and how (task programmability), and the ability to observe or identify who has done the work (task separability) (Sauvée 1998). When outcome measurability is high but task programmability is imperfect due to high transaction costs, contracts with outcome control measures are predicted. Conversely, a mixture of behaviour and outcome control measures are likely when task programmability is not costly. Low outcome measurability combined with high task programmability lends itself to behaviour control contractual mechanisms. In situations of low outcome measurability but imperfect outcome control, the predicted control strategy for the principal is "socialization" or "clan control" in which training and selection are used to minimize the divergence of preferences between principal and agent by establishing common goals (Eisenhardt 1985).

Agency literature explores optimal contract design under different environments. An optimal contract offered by the principal depends on the relative attitudes toward risk of the principal and agent and on the extent of moral hazard. Sheldon (1996) suggests contracts that induce the agent to exert the right amount of effort likely will include elements of both a time rate and a piece rate, such as some hog production contracts in which the farmer is paid a flat fee plus a performance incentive. Tournament contracts compensate the agent on the basis of his/her performance relative to other agents but often also have an element of time rate compensation to partially insure the agent against risk.

The study of the contracting problem using agency theory is a study of incentives. It assesses the optimal contractual relationship between principal and agent given information asymmetry and relative degrees of risk aversion. It enhances our understanding of how and why different contractual relationships evolve (and why they fail). Arguably, it has less to say about the "bigger picture" of how different vertical coordination systems evolve and why strategic alliances and closely managed supply chains (or "value chains") are evolving in some sectors.

6.3 Competency/Capabilities Approach

The transaction cost, principal-agent and contracting literatures have been criticized for focussing on contracting problems and incentives to the exclusion of other explanations for the existence and nature of firms. A collection of work is emerging which focuses on the "core competencies" or internal "capabilities" of firms as an explanation for the evolution of firms and industries. The body of work remains somewhat disparate, being referred to alternately as the "competency" approach, the "capabilities" approach or as a branch of "evolutionary economics." The competency approach is heterogeneous, drawing on business history, strategy, evolutionary economics and technology studies (Langlois and Foss 1997). Hodgson (1998) explains the situation as follows: the contractual approach (including transaction cost economics and agency theory) is centred on the informational difficulties involved in devising, monitoring and

policing contracts in a world of uncertainty and bounded rationality. In contrast,

> *"...from the competence perspective the existence, structure and boundaries of the firm are explained in some way by individual or team competencies – skills and tacit knowledge – that are in some way fostered and maintained by that organization." (Hodgson 1998, p. 180)*

In a sense, this literature takes a more humanistic view of firms, with the firm viewed as a "repository of knowledge" (Fransman 1994, p. 715). Teece et al. (1994) define a firm's competence as:

> *"...a set of differentiated technological skills, complementary assets, and organizational routines and capacities that provide the basis for a firm's competitive capacities in one or more businesses." (p. 18)*

Different firms will have different "skill sets," just as individuals differ in their aptitudes for different tasks – individuals and organizations are necessarily limited in what they know how to do well. Core competencies influence the scope of the firm's activities and provide motivations for different types of vertical relations as firms seek to maximize the outputs of their own capabilities or expand those capabilities through cooperation or integration.

Knowledge, which is central to the competency approach may be "codifiable" knowledge, "tacit" knowledge and "distributed" knowledge (Sachwald 1998). Codifiable knowledge is information that can be specified in formulas and designs, can be patented and can be transferred between firms by exchanging ownership rights. Tacit knowledge cannot be described and specified in well codified forms. Much knowledge about production is tacit, in the sense that it is acquired gradually over time in a process of learning-by-doing. Furthermore, some of the production knowledge is "distributed" knowledge. It is valuable only if used in conjunction with the knowledge of others and therefore it requires cooperation between firms or managerial direction within a firm for efficient use of this information (Langlois and Foss 1997). Transferring tacit knowledge between firms is complex, subject to uncertainty and apt to create high transaction costs. It provides a motivation for closer vertical relations, cooperative agreements, joint ventures or a within-firm transfer of knowledge in a vertically integrated firm (Sachwald 1998).

Revisiting the classic Coasian story regarding the existence and boundaries of a firm, the competency theorists argue that when transactions are organized as a series of market exchanges between independent self-producers, the transmission of information and knowledge between these individuals is impeded. The durability and longevity of the firm as an organization facilitates organizational learning and the transmission of information between production stages:

> *"...Often this practical knowledge – in the form of competencies – can exist in the body of an organized group of individuals only: it would not survive in a world of contracting and re-contracting individual agents." (Hodgson 1998, p. 192)*

Hodgson goes on to argue that in world of complete contracting (i.e., without firms), productivity growth would be lower, and once a firm did emerge, its higher productivity would drive self-producers out of business. The firm's knowledge economies would be its competitive advantage. Thus, firms emerge in circumstances in which they are able to coordinate the collective learning process more efficiently than is possible through open market transactions. Equivalently, the capabilities or competencies of the firm set limits on its boundaries. These limits are particularly apparent when one considers the process of innovation and technological change. Competency theory suggests that the technological capabilities of the firm determine its boundaries.

Competency-based theorists criticize transaction cost economics for taking a static equilibrium approach, while they view the evolution of an industry as a dynamic, disequilibrium process. Drawing an analogy with nature, Hodgson (1998) argues that a snapshot may show the costs of one governance structure to be less than another, just as a single snapshot in nature shows a predator destroying its prey, yet the ongoing process of evolution may leave both species enhanced. Thus, as firms evolve they impact the structure of the marketplace, which changes the competitive environment for firms, further stimulating the firm to evolve new capabilities.

While many writers of the competency/capabilities approach view it as an alternative to the contracting transaction cost approaches, Langlois and Foss (1997) argue that the two approaches should be complementary. In a sense, what has emerged is a separate treatment of production and transaction costs as determinants of organizational structure, when in fact they should be considered simultaneously. Thus, economic organization is a matter of efficiently aligning incentives while considering the motivations provided by the capabilities or competencies of the firm. Langlois and Foss (1997) provide suggestions for how these approaches may be considered jointly. For example, they argue that firm capabilities may influence the outcomes of principal-agent type problems. The fact that few firms are vertically integrated across the entire supply chain from input provider to consumer may be explained by the notion that as firms move away from their core businesses, information asymmetry manifests itself in growing adverse selection and moral hazard problems because it becomes more difficult for management to monitor employees or their outputs efficiently. As a result, agency costs rise and managerial diseconomies set in.

One can apply this reasoning in an agricultural context. We rarely see vertical integration forward by producers into food retailing or backward by retailers into agricultural production because inefficiencies arise when firms move away from their core competencies and incur large agency costs in coordinating activities internally. Perhaps cooperation through long term relationships and strategic alliances are the transaction *and* production cost economizing form of vertical coordination when one considers transaction characteristics and internal firm competencies simultaneously. The competency/capabilities approach offers interesting insights into the dynamics of firm growth. Paradoxically, its diverse background, drawing on a range of disciplines, may also be its Achilles heel in applied economic research. The competency/capabilities approach appears to offer little in the way of testable hypotheses or predictive assertions which are the "bread and butter" of applied economic analysis. Nevertheless, in combination with other theories of firm behaviour, this approach enhances our understanding of the changing nature of vertical coordination.

6.4 Strategic Management Theory

Relative to the previous approaches, the strategic management literature takes a somewhat more pragmatic, functionalist view of the firm. Porter (1991) describes a firm as a collection of discrete, interrelated activities including the assembly of products, making sales visits, and processing orders.

Spearheaded by Porter, an important component of the strategic management literature focuses on how firms attain competitive advantage. The solution, according to Porter, stems directly from his definition of what a firm is and what a firm does. Thus, competitive advantage results from the ability of the firm to perform the same activities at a lower price than rivals or to create buyer value to enable the firm to command a premium price (Porter 1991).

The strategic management literature considers questions of vertical coordination within the context of firm strategies to attain or improve competitive advantage. The focus is on internal firm strategies and internal organizational issues rather than the inter-firm, industrial structure focus of the organizational economics literature (transaction cost economics, agency theory, etc.). The strategic management literature is extremely broad, encompassing a plethora of managerial and firm strategy questions. For the purposes of this report, it is useful to focus on contributions to the literature which combine aspects of strategic management and organizational economics to provide insights into vertical relations between firms. Following a review of the economics and strategy literatures, Mahoney (1992) classifies the motives for closer vertical relations between firms (focussing mostly on full vertical integration) into four groups: transaction cost considerations, strategic considerations, output and/or input price advantages, and uncertainties.

Transaction cost considerations include information asymmetry, bounded rationality, opportunism and asset specificity.

Strategic considerations include, among others, the desire to create barriers to entry, to raise rivals' costs by restricting the number of suppliers and by increasing the capital requirements of market entry, and to mitigate the impacts of regulatory price control through the use of transfer pricing in a vertically integrated firm. Thus, firms engage in closer vertical relations to enhance their competitive advantage with respect to actual or potential rivals.

The output and/or input price advantages suggest that in highly concentrated industries, firms vertically integrate to "jointly" profit maximize over successive production stages, avoiding monopoly prices charged by upstream firms. Mahoney (1992) reconciles two apparently conflicting empirical findings regarding the impact of increasing uncertainty over costs and prices on vertical integration. In the Williamsonian view, an increase in uncertainty leads to more vertical integration, assuming the level of asset specificity remains constant. This view is essentially a comparative statics argument. Harrigan (1985) found the opposite—that increasing uncertainty led to less vertical integration. Mahoney attributes this difference to the dynamic approach used by Harrigan, i.e., over time the presence of uncertainty may lead a firm to utilize less firm-specific assets, such that less vertical integration is observed in the long-run.

While much attention has been paid to the motivations for, and advantages of, vertical integration, less attention has been given to the converse—the disadvantages of vertical integration. Mahoney (1992) stresses the importance of a "comparative institutional assessment" (p. 569). His discussion of the disadvantages of vertical integration encompasses the cost structure, flexibility and internal managerial monitoring costs of firms. The disadvantages are classified into three categories: bureaucratic costs, strategic costs, and production costs.

Bureaucratic costs include a range of managerial diseconomies related to the increased costs of coordination, control and communication within the firm. There also may be inefficiency losses due to the loss of competitive discipline brought by open market transactions. As the firm vertically integrates away from its core business, new skill sets are required (these ideas are shared by the competencies/capabilities literature). Strategic costs include the loss of access to information and tacit knowledge previously gained through relationships with experienced suppliers, a decrease in strategic flexibility and high exit barriers. Production costs include economies of scale considerations in the use of inputs, i.e., failure to use sufficient quantities of a vertically integrated input results in production of that input at less than minimum efficient scale.

Some recent contributions to the literature present possible bridges between the fields of strategic management and organizational economics.[7] Boone and Verbeke (1991) suggest that the optimal degree of vertical coordination depends on the level of asset specificity and on the importance of innovation and flexibility in competitive strategy. They argue that high bureaucratic costs often make the extremes of spot market transactions and hierarchy inefficient, such that "strategic networks of contractual arrangements" emerge. In their analysis, the transaction cost motivations for vertical integration are weakened if one considers the need for flexibility in corporate strategy in response to changes in demand or technology. Other writers have criticized the transaction cost approach as offering only a theory of market failure and not an explanation of why a firm succeeds (Hennart 1994). Instead, a broader notion of the "organizing costs" for a firm and a distinction between intra-firm and inter-firm transactions are proposed. The former are transactions mediated by employment contracts, the latter are contracts for outputs. Competitive advantage is gained from choosing the appropriate mix of contracts and from improving their efficiency. Differences between firms in their organizing capabilities lead to differences in competitive advantage (Hennart 1994).

Other attempts to integrate the insights of the strategic management and organizational economics literatures to provide a better understanding of the *intermediate* ground between spot market transactions and full vertical integration focus on the motivation behind interdependencies between firms. Zajac and Olsen (1993) suggest that the motivation for closer vertical relationships is more than simply the minimization of transaction costs (although this remains part of their explanation); it also involves a desire to create or to maximize value for both firms. Their analysis focuses on the *process* of decision-making within the firm and posits that the choice of governance structure is unpredictable in any definitive sense, given the vagaries of that decision process across different firms.

The strategic management literature is extremely diverse. It contains useful insights into the internal motivations for vertical integration and other forms of close vertical relations, while providing a counterbalancing view of the managerial disadvantages of these strategies. It also supplements the organizational economics literature. Thus, while the organizational economics literature provides us with a firm theoretical foundation upon which to draw predictive assertions, the strategic management literature enriches this model by providing an improved understanding of managerial motivations. In the process of "industrialization" and concentration in some parts of the agri-food sector, the influence of these strategic considerations on vertical coordination outcomes increasingly will become more important.

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[7] This discussion draws on Sauvée (1998).

6.5 Convention Theory

According to Sauvée (1998), the French school of convention theory is not yet structured into a single theoretical paradigm. However, it provides insights into the "middle ground" between open market transactions and hierarchies. Conventions are "a set of mechanisms and rules that involve private agents as well as public institutions" (Sauvée 1998, p. 44). The solutions for quality uncertainty has been a focus of convention theory. In well-functioning markets with perfect information, quality can be assessed easily and prices reflect all relevant quality characteristics. However, once we introduce uncertainty about quality, quality conventions are necessary to help coordinate that transaction.

There are four types of coordination to provide appropriate quality: domestic coordination which relies on trust and long-term relations built on reputation, industrial coordination in which an independent third party defines a set of norms or standards, market coordination which will suffice in the absence of uncertainty over quality, and civic coordination in which there is a collective commitment to avoid conflicts in the absence of uncertainty (Sauvée 1998).[8]

In situations of high uncertainty, domestic coordination will prevail if quality can be defined internally to the relationship through brand reputation or trust. Industrial coordination will prevail when quality is determined best by externally established standards or specifications. Convention theorists argue that conventions are part-and-parcel of the competitive process, affecting firm's strategic decisions and the competitive environment.

Convention theory incorporates a political economy approach to the study of vertical coordination, with the conventions which emerge influenced by their political and economic context. The philosophical roots of this approach probably lie in the centralized decision making and formal institutions which have typified the French economy. Centralized standards and contracts, e.g., specifying quality standards, price discovery processes and/or risk sharing have been more prevalent in the French economy than in the Canadian or US economies. As the demand for differentiated agricultural products and the level of competition increased, the need for new quality standards and more flexible price discovery mechanisms means that centralized industrial/civic coordination has given way to industrial/market coordination (Sauvée 1998). An important lesson from convention theory is that the wider institutional environment can influence contract terms—e.g., whether there are independent third party standards on which to base a contract—and should therefore be included in any analysis of vertical coordination.

6.6 Synthesis of the Theoretical Literature

The preceding discussion is intended as a summary of some of the pertinent theoretical approaches to the analysis of vertical coordination in agriculture. Although the approaches are discussed separately, it is worth emphasizing that while these approaches differ in many respects, the borders between them are by no means impervious. This crossover is particularly evident with organizational economics approaches (transaction cost economics and agency theory) but we also find mention of transaction costs in strategic management theory and mention of firm competencies in both competency/capabilities theory and strategic management theory. Indeed, it is probably the case that a comprehensive analysis of the changing nature of vertical coordination needs to draw on all of these theoretical approaches.

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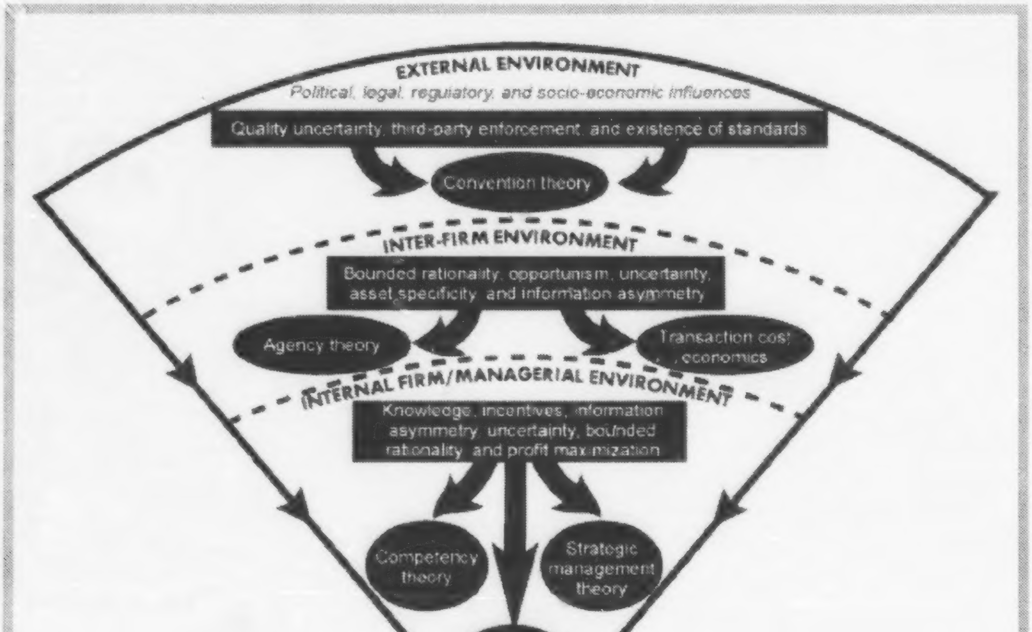
[8] Sauvée's discussion is based on Eymard-Duvernay (1989).

To understand how they differ, how they are similar and where gaps lie, it is useful to conceptualize these approaches in three broad groupings as illustrated in Figure 2. The boundaries between the groupings are depicted with dashed lines to indicate that the concepts embodied in these theoretical approaches are shared and may contribute to our understanding of vertical coordination at more than one level. Key concepts or underlying assumptions of the theoretical approaches are included in the boxes.

Strategic management theory, competency/capabilities theory and the neoclassical theory of the firm are placed at the base of Figure 2 because they provide explanations of *internal firm* motivations and limitations on the nature and boundaries of firms. Convention theory is placed in the outer wedge because it encapsulates the *external institutional environment* within which vertical relationships are established. The broader socio-economic, political, legal and regulatory environments, as well as specific conventions which govern inter-firm relationships, affect the vertical coordination process.

Figure 2: Synthesis of theoretical approaches to vertical coordination


EXTERNAL ENVIRONMENT
Political, legal, regulatory, and socio-economic influences
Quality uncertainty, third-party enforcement, and existence of standards
Convention theory
INTER-FIRM ENVIRONMENT
Bounded rationality, opportunism, uncertainty, asset specificity, and information asymmetry
Agency theory
Transaction cost economics
INTERNAL FIRM/MANAGERIAL ENVIRONMENT
Knowledge, incentives, information asymmetry, uncertainty, bounded rationality, and profit maximization
Competency theory
Strategic management theory
Neoclassical theory of the firm

Central to any study of vertical coordination in agriculture, however, are transaction cost and agency theories. These form the cohesive bonding between all of the theoretical approaches. In other words, organizational economics ties aspects of strategic behaviour and intra-firm organization to the external institutional environment in which firms operate. The strength of transaction cost economics and agency theory lies in their predictive abilities. They are built on well-defined behavioural and informational assumptions. Testable hypotheses can be derived, e.g., regarding the implication for governance structures of a change in transaction characteristics (uncertainty, frequency, asset specificity) or the impact of informational asymmetries on the choice of contractual form. To be sure, developing testable hypotheses involves putting things in boxes, thereby categorizing vertical coordination outcomes on the basis of a few determinant variables (transaction characteristics or transaction/agency costs) which may be open to the charge of oversimplification. However, a theoretical base on which to build testable hypotheses is a necessary first step in building a clearer picture of the world, albeit a structured, analytical picture. The strategic management, competencies and convention literatures enrich this base.

A synthesis of these approaches offers scope for further research, at the not-inconsiderable risk of muddying the theoretical waters. Whether this is a fruitful avenue of research depends if, at the margin, the improvement in our understanding of the changing nature of vertical coordination outweighs the loss in theoretical neatness from not focussing on one approach alone. An initial review of the literature suggests that this is likely the case. In particular, more attention needs to be paid to the middle-ground of vertical coordination alternatives, moving beyond the basic "make" or "buy" decision (should we or should we not be vertically integrated). The distinction between strategic alliances, joint ventures, long-term contracting and "value chains" is not as robust and should be the focus of future research.

A Conceptual Framework for Closer Vertical Linkages

This part of the report presents a conceptual framework for analyzing the factors affecting vertical coordination in agri-food sectors. It is based primarily on transaction cost economics but also borrows insights from the other theoretical approaches outlined in Section 6. The framework is then applied to a case study of the U.S corn and soybean sectors.

7.2 Transaction Characteristics, Costs and Vertical Coordination

Changes in transaction characteristics alter transaction costs, thereby influencing vertical coordination. Table 2 depicts the relationships between generic product features and transaction characteristics, ceteris paribus. It also depicts the relationships between key regulatory and technological drivers and product characteristics. First, we examine the transaction characteristics: uncertainty, frequency, asset specificity and complexity.

There are four types of transaction *uncertainty*: product quality, reliability of supply, price, and finding a buyer.

There is uncertainty for the buyer over product quality which results in the buyer incurring sorting costs in determining a product's true quality (Barzel 1982). Agency theory suggests that this uncertainty will be higher in situations of low task programmability when it is costly for the buyer (principal) to monitor directly the actions of the seller (agent).

Buyer uncertainty also arises with respect to the reliability of supply (both in terms of timeliness and quantity), creating a long-run planning problem. For example, a French fry manufacturer must have timely supplies of potatoes to fulfil its own contracts with fast food restaurants.

Both buyer and seller face price uncertainty, which also creates a long-run planning problem. At the time a production decision is made, there is uncertainty over the prices that will be received or paid for agricultural produce at time of delivery.

Sellers may face additional uncertainty in finding a buyer, particularly if their product has idiosyncratic qualities. This uncertainty raises their information or search costs. As uncertainty increases (assuming asset specificity remains constant), we expect closer forms of vertical coordination to be selected over open market transactions because of increased information and monitoring costs. Following Mahoney (1992), if the long-run presence of uncertainty causes firms to invest in less specific assets over time, closer vertical coordination may take the form of strategic alliances or contracts rather than full vertical integration.

Frequency refers to how regularly transactions are conducted. In situations of low uncertainty, highly frequent transactions tend to be carried out in the spot market because they induce learning and because reputation effects become important, mitigating against opportunistic behaviour.

Asset specificity arises when one party has made an investment in a production process specific to one buyer or seller, thereby locking themselves into that relationship for a period of time. Transactions involving specific assets leave firms vulnerable to opportunistic behaviour and lend themselves to contracting or vertical integration as the choice of governance structure due to the high monitoring and enforcement costs associated with spot markets. (Williamson 1979, Douma and Shreuder 1992, Hobbs 1996c).

In addition to uncertainty, frequency and asset specificity, the *complexity* of the transaction may be an important characteristic. As complexity increases, a variety of outcomes become possible. Complexity mitigates against spot market transactions. A more detailed contract would be required, with a greater number of contingencies to deal with the added complexities of the transaction. Higher transaction costs are incurred in writing fully contingent contracts in situations of complexity. If the transaction costs become sufficiently high, vertical integration may occur, with the transaction carried out in response to within-firm managerial orders. A strategic alliance, which allows sufficient flexibility in the relationship to deal with the complexities, is a further possibility. In the presence of asset specificity, high levels of complexity tend to result in vertical integration because of the monitoring and enforcement costs which arise in bilateral contractual arrangements or strategic alliances.

Table 2: The relationship between product characteristics, drivers and transaction characteristics

	Transaction characteristics						
	Uncertainty for buyer: *quality*	Uncertainty for buyer: *reliable supply (timeliness and quantity)*	Uncertainty for buyer and seller: *price*	Uncertainty for seller: *finding a buyer*	Frequency of transaction	Asset-specific investment	Complexity of transaction *(variety of outcomes)*
Product characteristics							
Product perishability	+	+		+	+		+
Product differentiation	+	+	+	+		+	+
Quality variable and visible		+	+	+			+
Quality variable and invisible	+	+	+				+
New characteristics of importance to consumers	+	sometimes	+	+		+	+
Regulatory drivers							
Liability	+			+		sometimes	+
Traceability				+		+	+
Product standards and grades	-			+/-		-	sometimes
Technological drivers							
Company-specific technology						+	sometimes

Table 2: The relationship between product characteristics, drivers and transaction characteristics

	Transaction characteristics						
	Uncertainty for buyer: *quality*	Uncertainty for buyer: *reliable supply (timeliness and quantity)*	Uncertainty for buyer and seller: *price*	Uncertainty for seller: *finding a buyer*	Frequency of transaction	Asset-specific investment	Complexity of transaction *(variety of outcomes)*
Product characteristics							
Product perishability	+	+		+	+		+
Product differentiation	+	+	+	+		+	+
Quality variable and visible		+	+	+			+
Quality variable and invisible	+	+	+				+
New characteristics of importance to consumers	+	sometimes	+	+		+	+
Regulatory drivers							
Liability	+			+		sometimes	+
Traceability				+		+	+
Product standards and grades	-			+/-		-	sometimes
Technological drivers							
Company-specific technology						+	sometimes

7.3 Relationships Between Product Characteristics and Transaction Characteristics

Following the framework outlined in Figure 3, the product characteristics listed in Table 2 affect the characteristics of the transaction, thereby influencing the vertical relationships which evolve. Five key product characteristics are identified: product perishability, product differentiation, the variability and visibility of quality, and new characteristics of importance to consumers.

Product perishability creates uncertainty for the buyer with respect to product quality and the reliability (i.e., quantity) of supply. It creates uncertainty for the seller in locating a buyer, as perishable products must be moved quickly to the marketplace to avoid deterioration, leaving sellers unable to store the product until favourable market conditions emerge. Perishablity also means that transactions must occur frequently. Perishability adds to the complexity of a transaction because the quality of the product can deteriorate. Buyers incur sorting or information costs if this occurs. Perishability also increases negotiation costs, as procedures are required for establishing which party (buyer or seller) is responsible for product quality at different stages of the transaction. For example, does the processor take ownership of the product upon collection from the farm, upon delivery to the processing plant or during storage. Examples include the production and processing of fresh fruit and fresh vegetables (Lang 1980).

Increasingly, product differentiation is becoming more common. Buyers face increased uncertainty over the quality and reliability of supplies since sellers of these differentiated products are not highly substitutable. An example from the grains sector is the development of grains exhibiting enhanced characteristics for specific end uses (Kennett et al. 1998). There is more price uncertainty, largely because product quality can vary and price will be tied to quality. The transaction becomes more complex and a variety of outcomes are possible. In many cases, the parties to the transaction have made an asset-specific investment: sellers differentiate their product to the specifications of an individual buyer while the buyers tailor their production or distribution practices to the products of specific sellers. Borrowing from the competencies/capabilities approach, the change in transaction characteristics requires access to new skills and knowledge which can be provided by alternative supply chain relationships.

When *product quality is variable yet visible* prior to purchase, there is buyer uncertainty over finding sufficient supplies of the good, but not over the quality actually received since this can be detected prior to purchase. However, price uncertainty arises in a dynamic world if prices are related to quality. Buyers and sellers cannot be sure of the prices they will pay/receive for a commodity in the future because they do not know in advance what the quality will be. In this situation the transaction becomes more complex. Convention theory suggests that long-term relationships will suffice as a vertical coordination mechanism if there is a high level of trust between the parties and if reputations are important since it is fairly easy to evaluate quality prior to purchase.

If *quality is variable but those variables cannot be detected by buyers* prior to purchase, buyers face additional uncertainty over product quality. When livestock sold on a live weight basis, e.g., processors are unable to determine accurately the eating qualities of the meat based solely on the characteristics of the live animal. Convention theory suggests that industrial coordination, in which an independent third party defines a set of norms or quality standards, has a role to play. Agency theory suggests that a contractual relationship, in which behaviour control mechanisms are used, will be important. If it is costly, or not possible, to measure the quality of the outcome, more information about (control over) input processes (agent behaviour) will be used to provide the requisite quality incentives to agents. This suggests a proactive role for downstream firms (principals) in the production practices of upstream suppliers (agents).

Scientific developments, including modern biotechnology, are introducing products with *new characteristics* of importance (both positively and negatively) to consumers. For example, eggs high in essential Omega-3 fatty acids which lower blood cholesterol have been introduced. In other cases, process attributes may be important to some consumers who seek reassurance that the product was produced using "acceptable" production practices—e.g., with respect to animal welfare, environmental impacts, child labour practices, etc. Often these characteristics cannot be detected visually prior to purchase. Buyer uncertainty over the quality—and sometimes availability—of supplies, price uncertainty, uncertainty for the seller in finding a buyer, asset specificity and complexity all characterize this transaction.

7.4 Regulatory, Technological and Socio-Economic Drivers

Regulatory, technological and socio-economic drivers affect product characteristics or can influence the transaction characteristics directly.

Regulatory drivers

There are three regulatory drivers which are particularly important in many agri-food markets - liability, traceability and product standards and grades. These are noted in Table 2. Other regulatory drivers include competition/antitrust policies (which impact the transaction environment directly), regulations affecting access to financial capital, the provision of arbitration services to settle contract disputes, or specific regulations concerning the contractual legal environment for agricultural products.

Regulations can change the priorities or focus of a transaction. For example, the extension or strengthening of product *liability* laws along the supply chain may increase buyer uncertainty over the quality of an input because the consequences of poor quality are more severe. For this reason, sellers face greater uncertainty in finding a buyer and the transaction has become more complex and costly, resulting in closer vertical relations along the supply chain. For example, the 1990 Food Safety Act in the UK increased the legal liability of food firms, causing them to seek more information about (and, in some cases, control over) upstream production practices in the food supply chain (Hobbs and Kerr 1992). In December 1998, the European Union (EU) endorsed plans to extend product liability laws to farmers, whereas previously agricultural producers had been exempt.

In some cases, the need for *traceability* could be an outcome of increased legal liability but it need not always be. The requirement for full traceability of agricultural products in the event of a breakdown in food safety may be a regulatory requirement in itself. Several countries, e.g., the UK and Canada, are introducing compulsory trace back systems for cattle. Some industry groups have instituted their own trace back systems, e.g., in parts of the Australian and UK beef industries (Fearne 1998). Traceability may impact transaction characteristics directly by increasing the complexity of the transaction and by leading to asset-specific investments. These investments include identity preserved supply chains in which information about the origins, characteristics, processing and handling of the product is documented throughout the supply chain and participation in the supply chain is limited to specific parties. In a sense, this is a closed system and will lead to greater seller uncertainty in finding a buyer for producers not part of an identity preserved system. In general, we would expect increased traceability to raise the information and monitoring costs of occasional supply chain relationships, leading to closer vertical relations.

Product standards and grades reduce information costs, facilitating the measurement of quality, the sorting of agricultural products and the matching of buyers with sellers. Unlike many of the other product characteristics and aspects of the regulatory environment listed in Table 2, the existence of product standards and grades causes a decrease, rather than an increase, in transaction costs. A recognized set of product standards or grades reduces uncertainty for buyers and simplifies the search process. It may also reduce uncertainty for the seller in finding a buyer, provided that a sufficient number of buyers are searching for the product.[10] Product standards and grades should reduce the need for asset-specific investments since sellers will be producing to a common recognized standard (e.g., Quality A) rather than to the specific standards of an individual buyer. Transaction costs are reduced for buyers and sellers, provided that the common product standard or grade measures the product's attributes of importance to the buyers. In general, product standards and grades may reduce the complexity of a transaction, but, under some circumstances, they may increase the complexity by leading to a multi-tiered payment system based on a variety of potential quality outcomes.

Technological drivers

Technological drivers affect three product characteristics directly: product perishability and the introduction of new characteristics of importance to consumers, e.g., biotechnology can introduce novel characteristics. In other cases, technological drives affect transaction characteristics directly. Technology may limit alternative sources of supply, such as crop varieties resistant to a specific herbicide such as Monsanto's "Roundup Ready Canola." In the farmer-input provider transaction, this limits the alternative sources of input supplies by tying farmers to a specific seed company and/or herbicide provider. Biotechnology which tailors products to specific end-users introduces asset-specific investments and may increase the complexity of the transaction. As a result, the risk of opportunistic behaviour creates high monitoring and enforcement costs and provides an incentive for closer vertical coordination to reduce these transaction costs.

Technology which creates economies of scale from large-scale production/processing units, or allows tighter control over product quality through feeding, housing or other management practices, may also encourage closer vertical coordination and industry consolidation if it is less costly for a processor than dealing with larger numbers of small producers.

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[10] Arguably, product standards or grades could increase uncertainty for sellers of lower quality products if they enable buyers to discriminate more effectively between sellers on the basis of measurable quality characteristics.

Socio-economic drivers

Socio-economic factors can alter the transaction environment directly or through their effect on the demand for product characteristics. Changes in consumer lifestyles and preferences have increased the demand for branded, further processed meals, including home meal replacements. Product quality is extremely important and is signalled by a firm's brand name. To differentiate their products, to protect the investment in their brand name, and to reduce the monitoring costs of guaranteeing the quality of their inputs, processors will prefer closer vertical relations with their suppliers. Heterogeneous consumer preferences in international markets encourage product differentiation, moving the sector away from its traditional commodity orientation and encouraging closer vertical coordination. For example, Japanese consumers prefer pork of a deeper red colour and beef that is highly marbled with intramuscular fat—both products would be discounted in the North American market.

The product characteristics and environmental drivers listed in Table 2 are not intended to be exhaustive but illustrative of the types of factors which may have an influence on transaction characteristics. Changes in transaction characteristics alter transaction costs. For the most part, the changes illustrated in Table 2 raise the costs of transacting through spot markets, thereby leading to closer forms of vertical coordination, such as strategic alliances, contracting or full vertical integration. The framework provides a starting point for analysis, to which additional product characteristics and environmental drivers may be added.

Section 8

Application of the framework: the case of US corn and soybeans

This section evaluates changes in the US corn and soybean sectors using the framework outlined above. Many of these changes also apply to the Canadian canola, corn and soybean sectors. Technological developments have been a major driver for change in the corn and soybean sectors. These developments include grain testing, information technology, and use of genetic engineering in plant breeding. Consumer preferences for grains with enhanced health characteristics and livestock feeder preferences for grains with enhanced feeding value have contributed to these developments. The rapid increase in highly differentiated grain products has altered the product characteristics referred to in Table 2, with a corresponding change in the transaction characteristics. Contracting is increasing in importance as grain moves from being primarily a bulk commodity to also include differentiated products, with a smaller share sold in bulk.

8.1 New Grain Products and Closer Supply Chain Relationships

Some new varieties of corn and soybeans contain traits that are cost-reducing due to the introduction of input traits which provide resistance to herbicides and insects (Harwood 1997). Herbicide resistant varieties are genetically improved to tolerate herbicides (such as Roundup Ultra) and result in improved weed control and reduced input usage. Growers purchase a package of inputs including seed and herbicides from the same company. Of the new herbicide resistant varieties, Roundup Ready soybeans has the largest acreage, with 25 million acres planted in the United States in 1998, 34 percent of the total $US plantings (Sparks Companies Inc. 1998). An example of an insect resistant variety is Yield Guard corn, which provides in-plant protection from the European and Southwestern corn borers. In 1998, 13 million acres of Yield Guard corn were planted in the United States. Estimates vary, but in Canada up to 60 percent of canola seeded in 1999 was from genetically modified varieties (Western Producer 1999). Adoption of these varieties by producers has been rapid. Yield Guard corn acreage in the United States increased 70 percent from 13 million acres in 1998 to an estimated 22 million acres in 1999. Roundup-Ready and Yield Guard corn acreage increased 150 percent between 1998 and 1999, to an estimated 750,000 acres. Table 3 contains information on varieties of corn, soybeans and canola that have been introduced in the last few years.

Table 3: Selected grain products in the United States and Canada

Product	Characteristics	Development Method	Company	1998 Acreage million	1998 Acreage percent	Identity Preserved
Corn						
High Oil corn	oil content 5.8% or more	Ad. breeding	Optimum	1 US	1.2%	Yes
White corn	specific for snack foods	Ad. breeding	DeKalb/Custom	0.65 US	.8%	Yes
High Amylose corn	manufacturing use	Ad. breeding	DeKalb/Custom	0.04 US	.04%	Yes
Waxy corn	over 99% amylopectin	Ad. breeding	DeKalb/Custom	0.43 US	.5%	Yes
Liberty Link	herbicide resistant	Transgenic	AgrEvo	4.2 US	5.2%	No
IMI (imidazolinone) tolerant corn	herbicide resistant	Ad. breeding	American Cyanamid	6.6 US	8.2%	No
Roundup Ready corn	herbicide resistant	Transgenic	Monsanto	0.75 US	1%	No
Maximizer and Knockout corn	insect resistant	Transgenic	Novartis	2.0 US	2.5%	No
Yield Gard corn	insect resistant	Transgenic	Monsanto	13.0 US	16%	No
Roundup Ready and YieldGard corn	herbicide resistant and insect resistant	Transgenic	Monsanto	0.03 US	.04%	No
Canola						
Laurate canola (for oil)	high lauric acid—useful infood processing	Transgenic	Monsanto/Calgene	0.08 US	N/A	Yes
Roundup Ready canola	herbicide resistant	Transgenic	Monsanto	2.0 Canada	7.4%	No
Liberty Link canola	herbicide resistant	Transgenic	AgrEvo	2.1 Canada	16%	No
Pursuit Smart	IMI tolerant	Ad. breeding	Pioneer Hi-Bred	2.1 Canada	16%	No
Soybeans						
Roundup Ready soybeans	herbicide resistant	Transgenic	Monsanto	25.0 US 0.15 Canada	34%US	No
STS soybeans	(sulfonylurea tolerant)	Ad. breeding	DuPont	10.0 US	14%	No
High Oleic soybeans (for oil)	healthier frying	Transgenic	Optimum	0.03 US	.04%	Yes
Low Linolenic soybeans (for oil)	replace hydrogenated oils	Ad. breeding	Optimum	0.01 US	.01%	Yes
Low saturate (for oil)	less saturated fat	Ad. breeding	Optimum	N/A	N/A	Yes
LoSatSoy	low fat	Ad. breeding	Optimum	0.05 US	.07%	Yes
High sucrose soybeans	increased digestibility	Ad. breeding	Optimum	0.01 US	.01%	Yes
High protein soybeans	high protein	Ad. breeding	Optimum	0.01 US	.01%	Yes

N/A = information not available   Sources: Optimum Quality Grains 1999; Farmsource 1999; and Sparks Company 1998.

New varieties have been developed through both advanced plant breeding and transgenics (which involves the transfer of a gene from one organism to another). Some cost-reducing varieties, e.g., Imidazolinone (IMI) corn, have been developed through advanced breeding practices alone. Other insect resistant varieties, such as Yield Guard corn, have been developed through genetic engineering.

In general, the use of cost-reducing input-trait varieties has not changed in a significant way the output characteristics of the products or the relationship between producers and other members of the supply chain. The exception to this is a lack of consumer acceptance in Europe and other importing countries of foods containing GMOs. Consumer acceptance problems could lead to the development of identity preserved production and distribution systems for grain that has not been genetically modified. The change in product characteristics introduces uncertainty over product quality which did not previously exist.

Other corn and soybean varieties have enhanced value in end-markets due to changed output traits, such as an increase in the oil content in corn, or the improved healthfulness and digestibility of soybeans. The enhancement of *output traits* has very different ramifications for producers and for the supply chain as these products must be identity preserved to capture their values. The rapid development of a closely coordinated supply chain for high oil corn provides an example of how the industry has responded to this technological development. High oil corn, developed by Optimum Quality Grains, has an average oil content of 7.45 percent compared with 3.5 to 4.5 percent for common corn (Optimum Quality Grains 1999).

Optimum Quality Grains is a joint venture of the Dupont Company and Pioneer's Hi-Bred International Inc. aimed at developing and marketing value-enhanced grains. Optimum Quality Grains licenses its technology, such as its high oil corn, to independent seed companies. Producers can determine the availability, location and terms of contracts for the production of high-oil corn using the Internet. Optimum Sales Connection and Resource (OSCAR), an on-line contracting system, connects growers with grain elevators, livestock feeders and processors. Contracts for high oil corn are with Optimum, who partners with a network of elevators. Contracts specify the seed to be used, the point and terms of delivery, premiums for oil content and discounts for failing to meet other quality conditions. Payment is based on the market price for #2 yellow corn plus a premium based on the oil content of the corn. Contracts specify that Optimum Quality Grains and its agents may evaluate and inspect the condition of the crop. The movement of the high oil corn from elevators to domestic and foreign end users is tightly controlled by Optimum Quality Grains.

On-line contracts are available for other Optimum Quality Grains products. Contracts for sulfonylurea tolerant soybeans (STS) include conditions over the use of both seeds and herbicides and how the grain is to be identity preserved. In the language of the agency theory, this is an attempt to enhance task programmability and task separability in the contractual relationship with producers. Other companies are developing their own tightly integrated supply chains for output trait-enhanced grain varieties. For example, Dow Agrosciences is developing an identity-preserved channel for a new corn hybrid, Supercede, with contracts to link farmers, elevators, and livestock and poultry feeders (Dow AgroSciences 1999).

Grain varieties with enhanced output traits require specific production practices and identity-preserved marketing channels to capture the value of the traits in the seed. They provide a means by which a firm can gain competitive advantage over its rivals. Contracting is prevalent in value-enhanced corn, with estimates of 70 percent of waxy corn, 60 percent of white corn, and 40 percent of high oil corn produced under contract (U.S. Grains Council 1999). To date, these enhanced output trait varieties account for a small percentage of total grain production. However, substantial investment in R&D of these trait-enhanced varieties, and the number of products being developed, indicate that trait-enhanced varieties will become much more significant as a percentage of total grain crop production in the future.

8.2 Changes in Product and Transaction Characteristics

Largely as a result of technological change, the new grain products (see Table 3) have different product characteristics which have led to changes in the transaction characteristics presented in Table 2. Buyers must be assured that they are receiving the quality attributes that they desire and are paying for, and these attributes largely fall into the category of "variable and invisible," increasing buyer uncertainty. Uncertainty for sellers also increases. As growers bear additional costs in producing a grain with specific attributes, they need to be assured of a buyer who values those attributes. If livestock feeders or processing plants make asset-specific investments in expertise, infrastructure or equipment to use a value-enhanced grain, then they must be assured of a timely and adequate supply. Stringent quality requirements increase the complexity of the transaction due to the possibility that the producer's crop will meet some, but not all, of the requirements. Optimum Quality Grains contracts specify that its agents are allowed to inspect and to monitor high oil corn on contracted acreage—evidence of their need to reduce uncertainty by protecting their investment. It is also evidence of the use of control measures to govern the agency relationship, rather than simply relying on outcome measures.

Regulatory changes may further impact transaction characteristics. For example, the negative consumer reaction in Europe to products containing GMOs has resulted in the EU introducing mandatory labelling requirements for foods containing GMOs. This regulatory requirement will require greater traceability throughout the food chain to substantiate labelling claims, inevitably leading to closer supply chain relationships.

The changes in transaction characteristics increase the transaction costs of occasional vertical supply chain relationships and result in new linkages between producers and grain companies. The increase in contracting is a response to reduce uncertainty and to minimize agency and transaction costs.

8.3 Summary

Developments in the US corn and soybean sectors illustrate an application of the conceptual framework. In applying the framework to an agri-food sector, it is first necessary to identify the drivers for change in that industry. Next, the impact of these drivers on transaction characteristics—either directly, or indirectly through their effect on product characteristics—should be assessed. The standard predictions of transaction cost economics regarding the impact of uncertainty, frequency, asset specificity and complexity on transaction costs and, ultimately, on vertical coordination outcomes apply. The product characteristics, regulatory and technological drivers listed in Table 2 are by no means an exhaustive list, rather they serve to illustrate some of the key influences on the characteristics of a transaction. Modifications to this framework can be made in the light of future changes to the regulatory, technological and socio-economic environment.

Pricing, Policy and Market Failure Implications

The final part of this report discusses some of the implications of closer vertical linkages in the agri-food sector. Specifically, we consider the likely future structure of agricultural markets and supply chains, the implications for price discovery and price formation, the impacts on traditional agricultural support policies and regulatory marketing institutions and the appropriate role for government. Finally, we discuss an alternative view of the future direction of vertical relationships and conclude with some suggestions for future research.

Section 9

Price formation and associated issues

9.1 The Evolution of Agricultural Markets

To discuss the implications of increased vertical coordination in agriculture, we need an idea of what agricultural markets will look like in the future. Most analysts propose that there will be a mix of market types whose importance will change over time as agriculture continues to industrialize. Boelhje (1998) suggests that there will be three categories of goods: generic commodities, enhanced component commodities, and specific attribute raw materials. Boelhje believes that these products will be produced by at least three categories of agricultural producers. First, he predicts that the role of multiple plant entrepreneurs will increase, as advances in technology enable skilled producers to manage sizable operations in multiple locations. Secondly, he believes that some growers will become franchise growers operating with a system similar to that of McDonald's restaurants. Thirdly, he sees networks of qualified suppliers for particular processing operations, such as already exist in the broiler or pork sector. In Boelhje's opinion, *interdependence* between components of the supply system, not *independence*, will be the key word of the future.

Hamilton (1997) also proposes three categories of agricultural producers. The first will be an industrialized portion similar to the broiler industry, where the role of traditional family-sized farms will be limited. Instead, many farmers will have the status of employee in a sector that is increasingly concentrated, owned by corporations and vertically integrated. The second category will be made up of traditional family farms, probably larger than before, who are attempting to compete within the industrialized system. Producers may increase their role in downstream activities through marketing cooperatives or networks. The third category of producers, devoted to producing and marketing high quality food in nontraditional ways, is likely to grow. This category will include smaller scale diversified producers and niche marketers.

Brester and Penn (1999) also foresee a role for large family farmers that will continue to produce bulk (generic) commodities. They suggest that the number of producers of differentiated and identity preserved goods will continue to grow.

None of these forecasts are likely to be entirely accurate, yet they all appear to concur with respect to a broad trend for the agriculture sector. In general, the evolution of the sector to date suggests that it will be composed of a variety of products, both generic and highly specialized, and that the role of specialized products is likely to increase for some time. There will be no standard form of agricultural production and the concept of a representative farm will continue to decline in usefulness. A mix of organizational forms will exist at the farm level and within the entire marketing chain.

9.2 Bulk Commodity Markets

Price discovery in spot markets for homogenous commodities is well understood. For the purpose of this report, the relevant question is the extent to which the useful properties of spot markets can be maintained as the portion of production entering the spot markets shrinks, relative to the portion that is priced through contracts or through other mechanisms. The question then, is what is the minimum number of transactions needed to maintain a viable spot market. Although this question has been addressed in the past (see e.g., Tomek 1980) it may be difficult to answer on the basis of past research due to changes in technology. The use of the Internet vastly reduces search and information costs for buyers and sellers. It expands our traditional notions of the boundaries of a spot market and the number of potential buyers and sellers. For example, if one were interested in rice, a casual search brings up a newsletter on rice with international prices at different locations and with specific quotes for numerous qualities and varieties of rice (http://www.creedrice.com).

9.3 Contract Production Pricing and Associated Issues

Formula pricing

An increasing proportion of agriculture is produced under contract in both Canada and the United States. In 1997, around one third of US agricultural sales were produced under contract, making issues associated with contract pricing important. Formula pricing schemes are common for production under contract and involve transactions where the price is determined by formula and may be tied to a specific market price. In contract grain production, such as for high oil corn in the United States, payment is based on No. 2 yellow corn, with premiums based on the oil content of the corn. For corn, and several other commodities, the spot market plays a key role in providing a base price to which quality premiums are added. However, in other commodities, a spot market price is not used. For live turkeys in the United States, e.g., the price received by producers from processors is not related to the spot market price, but to a price quotation by the U.S. Department of Agriculture for frozen, ready-to-eat turkeys (Hayenga and Schrader 1980).

In the United States, formula pricing is used for eggs, both between the producer and first-handlers, and between the handlers and retail and food service sectors. Hayenga and Schrader (1980) report on the complicated arrangements that exist:

> *"Most contracts do not have a clear cut base price or premium established, just a handler's commitment to use his "best efforts" to achieve a "competitive price" for the producer." (p. 755)*

The egg price quotations typically used in formula-pricing arrangements are based on industry price reports such as Urner-Barry Producers' Price Current, which does not represent any specific graded-egg market transaction, rather it is based on changes in egg prices at other levels of the marketing system, changes in inventory levels and other factors. (Another example provided by Hayenga and Schrader, for cheese, was discussed in Section 3.3)

Performance incentives

Contracts for US broilers usually consist of base and incentive payments (Perry, Banker, and Green 1999). The base payment is a fixed payment per pound of meat produced. The incentive or performance payment rewards producers, either through a bonus for higher than average quality or for a higher than average volume of production. In these cases, the contract may be structured as a "tournament" between a comparative group of producers (Knoeber 1989). Examples of broiler contracts can be viewed at (http://www.web-span.com/pga/contracts/index.html). In these examples, payment is not related to a spot market price.

Price and quality information

One frequently cited concern over the increase in the use of contracts for agricultural production is the impact on the viability and existence of a spot market price. The concern is that as the percentage of production under contract increases the spot market becomes thin, thereby making the market clearing price more volatile and less representative of the good (usually a generic good). While a spot market price provides useful information, price is only one aspect of contract production. In many cases, production under contract will differ from generic commodity production, as contracts are often used to ensure that tight quality specifications are met. In addition, the contractual relationship may include many facets not captured by production of a bulk commodity, where the spot market provides a market clearing price. Access to new technology and to the opportunity to produce new commodities is one motivation to participate in contract production (Boelhje 1998). In fact, producers may grow several different grains on contract to remain on the lists of qualified producers for different companies. This may improve future opportunities to produce new products under contract and be part of a specific value-added supply chain.

Contract production is frequently associated with different costs and benefits to the producer than production for the spot market. For example, closer vertical linkages with processors may provide producers with access to additional information about the requirements of consumers, thereby enhancing the flow of market information back down the supply chain. This benefit is hard to quantify but it represents a reduction in information or search costs for the producer. At the same time, however, the producer is faced with a more complex transaction situation involving long-term contractual obligations and may have to choose between a number of potential contractual relationships, thereby raising information and negotiation costs for the producer. In general, spot market prices become increasingly irrelevant as contracts between producer and processors change the nature of their relationship and the specifications of the product produced.

It is helpful to keep in perspective what spot market prices provide to agricultural producers. The interaction of many buyers and sellers assures them that the price is the result of many transactions, and that a buyer with market power is less likely to have lowered the price. However, this does not mean that all producers will necessarily earn normal profits, or that they will be able to stay in production over the long run, as producers of products with viable spot markets have exited over the years. Spot prices also do not guarantee that producers will regard the price as fair. In some cases, producers regard a spot market price as unfair due to subsidies to production given by governments throughout the world. The international sugar market is often accused of being simply a dumping ground for product, and the spot market price is not regarded as fair. At other times the spot market price is not regarded as fair simply if it is low.

Access to supply chains

Concern is expressed over issues of market power held by commodity handlers and processors. Producers may have difficulty gaining entry to closely coordinated supply chains for various reasons. One obstacle to entry may be the requirement for sophisticated production skills, equipment or capital, factors that have prompted producers to exit from agriculture historically. Another reason is that processors prefer to lower their transactions costs by dealing with only a few producers, who contract to provide large volumes of the commodity in question. This might give rise to the multiplant entrepreneur that was envisioned by Boehlje, as discussed in Section 9.1. This highly skilled farmer would act as a manager, hiring other farmers to assist in production at various locations. A final reason is that a dominant processor with market power could purchase less of the input than would occur in a competitive market (monopsony). The likelihood of this occurrence depends on the market's elasticities, the contestability of the market, and therefore the degree of the processors' market power, as well as the firm's overall marketing and/or purchasing strategy. Further discussion of the implications of market power for public policy is made in Section 11.3.

Efficiency gains

Due to increased vertical coordination, the US broiler industry has increased its efficiency (Martinez 1999b). Farm production costs declined with the adoption of cost-reducing technology, facilitated by the use of production contracts. Market efficiencies were gained from vertical integration of the feed, hatchery, processing and feeding stages. With tighter control the industry was able to meet consumer needs for high-quality, convenient, and branded products. In addition, contracting and vertical integration enabled integrators to meet the needs of large scale supermarket chains and restaurants due to greater control over volume and quality. Martinez (1999b) illustrates the shift in the supply curve that has occurred, and suggests that there has been a shift out in the demand curve as well.

Collective bargaining and the role of commodity groups

While there have been clear efficiency gains in some industries due to increased vertical coordination, the possibility remains that large contractors will use their power to depress the prices paid for inputs, and to make other contract conditions disadvantageous for producers. This has motivated producers to form associations to bargain collectively with the processor, in a manner similar to labour unions—a role frequently assumed by producer organizations in Europe. In the United States, the Agricultural Fair Practices Act (AFPA) of 1967 offers some protection to farmers and ranchers. The AFPA prohibits handlers and processors from discrimination against or intimidation of producers due to membership in any organization or due to the exercising of their rights to organize associations of growers for the purpose of bargaining with handlers and processors for both prices and terms (Hamilton 1997, p. 8).

The protection given to producers through the AFPA is perceived to be inadequate. For this reason, the U.S. states of Maine and Washington have passed state laws to protect producers' right to organize. In addition, the National Contract Poultry Growers Association (NCPGA) has attempted to pass legislation to extend the protection given to growers to organize under the AFPA and the Packers and Stockyards Act of 1921 (Rural Advancement Foundation International 2000). Other groups, such as the Farmer's Legal Action Group of St. Paul, Minnesota, have played a role in organizing and educating growers and have had some success.

> *"Contracts also have changed as a result of the grower's cooperative approach...before, the companies would not negotiate...contractors have become much more flexible in recent months." (Marbery 1993, p. 24)*

In Canada, producers' rights to organize are protected by provincial legislation.

In addition to collective bargaining, Hamilton argues that commodity groups can play a key role in the development of fair contract terms. Commodity groups are well situated to bring together large and small producers, processors, integrators, attorneys, and others to address the development of contracts that will serve the needs of all parties (Hamilton 1995). In Great Britain, the National Farmers' Union, the Grain and Feed Trade Association and the United Kingdom Agricultural Supply Trade Association have been involved in developing standardized commodity contracts. Hamilton states that the involvement of producers and trade organizations in developing contacts has facilitated standardized industry practices and has improved contracts (Hamilton 1995, p. 40). The involvement of producer organizations is also likely to generate greater "buy-in" on the part of producers faced with the option of joining a closely coordinated supply chain by producing under contract for a specific processor. The processor's transaction costs in locating and negotiating with suitable suppliers are reduced.

Transparency and dispute settlement

Another concern over the increase in contract agriculture is a potential lack of transparency in the terms used in contracts. This concern can be addressed by requiring that contract terms be made public. Hamilton (1995) discusses regulations used to achieve transparency in producer-processor contracts by several U.S. states. For example, South Dakota requires all packers with gross annual sales of more than $100 million to submit copies of standard contracts, as well as statistics on the method of purchase, price and other contract terms (Hamilton 1995, p. 15). In addition, producer groups have taken measures to increase contract transparency. For example, the U.S. National Contract Poultry Growers homepage (http://www.web-span.com/pga) has contracts posted from numerous poultry integrators.

The number of legal disputes between producers and processors over the terms of contracts has also increased. For example, poultry growers have initiated a number of lawsuits against processors over disputes in contract law (Marbery 1993).

One response by U.S. states to the increase in producer-processor disputes over contracts has been to require mediation before allowing a court to hear the case. This approach has been taken by Iowa for disputes involving livestock production contracts and by Wisconsin for vegetable contracts. Another method, which avoids potentially costly legal battles or the strategic use of the threat of litigation by firms, is to have the contract specify the arbitration procedures to be followed in the event of a dispute.

Avoidance of costly disputes may also be facilitated by ensuring that contracts between producers and processors are complete (insofar as is possible) and equitable to both parties. Hamilton (1995) discusses a long list of questions that arise with the increased use of contracts, and suggests that many contracts do not adequately address these issues. In some cases involving grain production, the question of who owns the grain, and the type of contractual arrangement entered into, is important in determining if producers can participate in US farm programs. Who bears the risk of loss during planting, growing, harvesting, storage and delivery, potential liability for environmental damages, and eligibility for worker compensation are other important questions which are often inadequately addressed. These omissions increase the transaction risk for both parties. Writing fully contingent contracts, on the other hand, imposes a different set of transaction (negotiation) costs on the parties.

Another important question is how performance is evaluated, as payment of premiums may depend on meeting quality standards or achieving target volumes. If disputes arise over the performance evaluation, will they be resolved through litigation, arbitration, mediation or administrative fiat, wherein the party with the greater relative bargaining power decides? Finally, questions exist over the timing of payment, particularly when title to the goods is passed before payment is made.[11]

An evaluation of issues associated with the growth of contract farming should note the evidence that many farmers are happy with their contracts and plan to continue contract farming (Lewin-Solomons 1999), and that many integrators have waiting lists of growers who wish to obtain contracts but cannot (Hamilton 1995). Hamilton argues that one problem with contracts is that growers expect too much. If the processor is providing the technology and marketing strategy that lead to increased profits, and the grower is not, then it is unrealistic for the grower to expect a portion of those increased profits. Hamilton suggests that the goal of government involvement in contract law should be limited to facilitating a fair and informed business relation:

> *"If the laws are designed to make the parties equal in their economic power, or to make them share the economic benefits of the contract, then their purposes are not likely to be achieved... if laws try to make companies share the benefits, the companies will look for alternatives to do it themselves...." (Hamilton 1995, p. 43)*

9.4 Franchises

Some economists concerned with the evolution of agricultural production have suggested that franchises may become important in agriculture due to their potential advantages to producers (Hayes 1998, Boehlje 1998).

In most franchises, the franchisor (or chain) contracts with a small party (the franchisee) to sell a product or provide a branded service to customers (Lewin-Solomons 1999). A franchisee pays an initial fee to cover training and site development fees, which can be quite substantial, and a regular royalty on revenues. It is customary to have a long-term contract, however, the franchisor usually reserves the right to change the standards of operation with which the franchisee must conform.

One advantage of agricultural franchises is that the product is branded (Hayes 1998). Hayes asserts that funds spent on generic commodity advertising may be better invested in the promotion of branded products. Both Boelhje (1998) and Hayes (1998) argue that franchises may present a middle ground for producers. While producers may not be able to maintain complete independence, acting as a franchisee provides more opportunity for profit, skilled decision making and risk sharing than operating as a low-wage piece-meal contractor.

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[11] See Lang (1980) for an insightful discussion of this issue and an examination of how collective bargaining altered the incentive structure of various buyer-supplier relationships, leading to a change in behaviour.

Franchisees are vulnerable to hold-up, as franchisors may act opportunistically and change the standards of operation, or they may simply decide that a franchisee is not in compliance with standards and terminate the franchise. The hold-up problem results from the large and specific assets that the franchisee has invested. Lewin-Solomons (1999) investigates the arguments for, and the consequences of, government regulation of both franchisor-franchisee and grower-processor relationships, and notes many parallels between the two. Lewin-Solomons concludes that direct regulation interferes with the parties' attempts to optimize their contractual relationship. Collective bargaining by franchisees may address the problem of unequal power while maintaining flexibility in contract terms.

9.5 Monopolistic Competition

It is likely that high-quality and specialty agri-food products will continue to increase in importance. The forces behind this growth are primarily consumer concerns about food safety, their interest in other process attributes, their desire for locally grown and fresh products, and a continued increase in the demand for diverse products.[12] For example, one analyst predicts that "microfarmers" (small producers of specialty products) could reach 12–18 percent of agricultural markets in the next twenty years, serving up to 25 percent of consumers (Smith 1994).

To the extent that these products are considered to be differentiated goods, this agricultural sector may be represented by the model of monopolistic competition. In monopolistic competition, firms face downward-sloping demand curves as consumers view a firm's product as different from others in the industry. This allows a firm to price its products above its rivals (and above marginal cost) without losing all its customers. However, as entry is possible, firms are unable to make economic profits in the long run. In some instances customers may prefer products whose attributes are linked to location, such as locally grown produce, or "Big Sky Beef" or "Alberta Beef." If consumer loyalty to brands is weak, this sector becomes similar to perfect competition.

There are relatively few policy issues related to price formation in these markets. Some prices are determined in the spot market, as is the case with farm-gate sales. Others are the result of one-on-one negotiation between specialty producers and (often small-scale) specialty processors or retailers. There may, however, be policy issues with respect to the labelling or product claims which producers use to differentiate their products. For example, if claims are made about production methods ("organic") or about the location of production ("made in Saskatchewan"), there may be a role for industry or public standards to verify this claim, thereby enhancing the public credibility of the firm's differentiation strategy and preventing misrepresentation of products to consumers.

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[12] See Section 5 for a full discussion.

Section 10

Impact on existing agricultural policy arrangements

10.1 US Farm Policy

What are the implications of current and anticipated changes in the agricultural sector for US farm policy? These changes include a continuation of the trend away from bulk commodities toward highly differentiated products, such as specific attribute grain or livestock products produced to tight quality specifications. Further changes in the organization of production and supply chains, with continued increases in the role of contracting and multiplant farms, and the development agricultural franchises and other new forms of organization are expected.

The 1996 Federal Agricultural Improvement and Reform Act provides domestic and export policy for a range of US commodities. An important feature of the act is that producers of program commodities (namely wheat, corn, grain sorghum, barley, oats, rice and upland cotton) were given the opportunity to receive market transition payments for the years 1996–2002. These payments are based on enrolled contract acreage, not current plantings, in an effort to reduce distortions to production and trade. Many grain producers also received marketing loan deficiency payments when the market price dropped below the loan rate.

In 1996, US farm policy appeared to be on a course of less government support to the sector, with the adoption of a program to provide transition payments to producers, with the understanding that government payments to producers would cease at the end of the program. However, the US Congress passed a variety of supplemental measures in the last few years to support farm income, in contradiction to a path of removing government support. At present, the future of US farm policy is unclear. However, a few conclusions can be reached.

Currently, no systematic effort is made to target support to producers on the basis of the level or variability of income. Payments to producers for contract crops (as listed above) depends on historical acreage and US agriculture is extremely concentrated. In 1997, farms with sales under $99,999 accounted for 81.9 percent of farms but only 12.6 percent of sales (National Agricultural Statistics Service 2000). Farms with sales of more than $100,000 accounted for 18.1 percent of farms and for 87.4 percent of sales. In fact, the largest 3.6 percent of farms accounted for 56.6 percent of sales. Due to the importance of historical production in determining government payments, they are concentrated as well. For example, in 1997, 6.5 percent of farms, with sales of more than $50,000 received 37 percent of government payments. The correspondence between concentration in sales and government payments is not exact, due to the variety of government programs that exist, including conservation programs. If US farm policy continues in its present form, then payments will continue to be directed to large farms with substantial income.

Perhaps the most important implication of the anticipated developments discussed in this report is that producers need to be extremely proactive, in their individual

businesses and in prompting their producer organizations to undertake new roles. Individual producers may need to learn new skills. They need to be able to assess if their comparative advantage lies in continuing to produce for the bulk market, or if they should invest in the skills and equipment needed to compete in more highly specialized production. Many producers may need new skills to negotiate contracts advantageous to them. Producers will need to be acutely aware of their cost structure to make sound decisions over contract prices for specific goods and services. In addition, producers must ensure that their commodity groups are undertaking new roles as well, such as lobbying for changes in contract law or forming groups to perform collective bargaining with processors and integrators. A farm policy that provides direct payments to producers does little to assist producers in the strategic positioning required to remain competitive.

The uncertainty and ad-hoc nature of US farm policy does a great disservice to US producers. Many producers and their organizations focus attention and use resources to anticipate and influence the direction of a farm policy that will do little to prepare them for the further industrialization of agriculture. Several analysts have argued that producers must be farsighted and position themselves effectively during the upcoming period of change. We concur with that assessment.

10.2 Canadian Income Support Policy

In Canada, policy emphasis has shifted toward income support and away from commodity-based programs. For this reason, a move toward closer vertical coordination is likely to have fewer direct implications for the application of existing support programs. The Net Income Stabilization Account (NISA) provides farmers with a means of protecting their incomes against fluctuations and is not commodity-specific. To the extent that closer vertical relations might reduce price—and therefore revenue—fluctuations, and provide producers with improved information with which to plan production and estimate costs, arguably it could reduce the need for income stabilization policies such as NISA. In general, though, farmers will still have access to the NISA program and its provincial counterparts, regardless of their involvement in vertically related marketing channels or input supply relationships.

10.3 Marketing Institutions

Policy implications with respect to regulated marketing systems offer more scope for comment. Much has been written, debated and disputed about the role of the Canadian Wheat Board (CWB) and its impact on international markets. It is beyond the scope of this report to wade into the policy discussion of the relative pros and cons of the CWB. Instead, it is useful to examine the role of regulated marketing institutions, such as the CWB, from the perspective of their transaction cost impacts and the implications for vertical coordination.

Historically, the rationale for the CWB and other non-supply management marketing institutions was the need for countervailing market power for producers faced with oligopoly/monopoly power in downstream grain handling or food processing sectors or and oligopoly/monopoly power in upstream input supply markets. In a sense, these producer marketing organizations were put in place to prevent upstream and downstream firms (e.g., railway companies, grain handling firms, food processors) from capturing rents from the vertical market system, enabling instead these rents to be divided among producers. Where does this rent come from? If one accepts, for the moment, that the CWB does not have market power in world markets,[13] then this rent must come from the CWB's ability to lower transaction costs in the supply chain and to pass these cost savings back to farmers in the form of higher returns for their grain.

How, then, might the CWB lower transaction costs? Ostensibly, through its coordinating role in Canadian wheat and barley export markets. The CWB has a number of departments which contribute to market intelligence and analysis of market demands and the availability of supplies (e.g., Weather and Crop Surveillance, Market Analysis, Risk Management, Transportation, Country Services, Planning and Coordination departments). Information costs are reduced by the ability to coordinate market development activities with sales functions and with supply predictions. Negotiation costs may be lower collectively by funneling export sales negotiations through CWB negotiating teams, who are backed by an extensive system of industry information collation and analysis. Monitoring and enforcement of downstream transactions in export markets is facilitated by the organization's large information base. For example, because it has a more extensive resource base of personnel and expertise in international markets, it may be easier for the CWB to determine whether failure to honour a contractual agreement is for reasons beyond the control of the buyer, or because a buyer is acting opportunistically and reneging on a contractual commitment to purchase Canadian wheat or barley at the pre-agreed price. Similarly, non-supply management marketing boards have a transaction-cost reducing role in coordinating marketing activities, conducting market research, reducing information and negotiation costs, etc.

If regulated marketing institutions were the transaction cost efficient method of coordinating downstream marketing activities and exporting, however, it could be argued that they do not also need statutory monopoly power to achieve their objectives. The rents gained from savings in transaction costs and from countervailing power would be available to producers without the need to also control the volume of supply. The extent to which this is the case is an empirical question. Central to this question is the identification of transaction costs in the downstream marketing of the products and an assessment of the extent to which the marketing institutions are transaction cost economizing compared to less regulated forms of marketing. Further research, with a focus on transaction costs, would help inform this debate.

In most cases, regulated marketing systems have been established for relatively homogenous agricultural commodities—wheat, barley, eggs, milk, etc. One of the justifications for these institutions is that market failure results in an underinvestment in R&D, market development and promotion because of the unbranded, commodity nature of the products. This prevents a private firm from capturing the rents from investing in R&D, market development or promotional activities. Therefore, these activities are undertaken collectively by the marketing institution on behalf of the entire industry. As the earlier discussions in this report indicate, however, a major change occurring in agri-food markets is the move toward highly differentiated food products servicing different consumer segments. For example, "designer eggs" high in essential omega-3 fatty acids are now on the market. In the UK, a brand of eggs has been launched that differentiates the eggs on the basis of their guaranteed salmonella-free status. The eggs are sourced only from flocks vaccinated against salmonella and each egg is

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[13] Admittedly, a controversial question.

stamped individually with the company's brand logo. The case study of US corn and soybeans discussed in this report indicated ways in which these industries are differentiating what have traditionally been commodity crops, resulting in a move toward vertical coordination through contracting.

An interesting question arises. Will Canadian regulatory marketing institutions, such as the CWB, remain (assuming that they currently are) the transaction cost economizing method of vertical coordination as differentiated agricultural products gain in importance relative to bulk commodities? Would coordination through contracts or strategic alliances between independent firms and individual (or groups of) farm firms be better placed to reduce transaction costs in the markets for highly differentiated food products with quality attributes which are "variable and invisible"? The conceptual framework presented in this report suggests that these changes in product characteristics alter the characteristics of the transaction, resulting in closer vertical relationships between farmers and downstream food firms. Whether regulatory marketing institutions still have a role to play in this scenario is open to debate.

On one hand, it could be argued that the ability to collect and to collate information about market needs and to coordinate vertical marketing activities means that these institutions are still transaction cost efficient, albeit with a need to adapt quality measurement, payment methods and producer contractual relationships to reflect the new realities of the food industry. As alluded to in Section 4, it appears that the contractual arrangements between the UK bread manufacturer Warburtons, Agricore and prairie wheat farmers succeeds within the CWB structure (Kennett et al. 1998).

On the other hand, it may be that the current regulatory structure in some Canadian industries inhibits the closer producer-processor relationships necessary for efficient information flows and the further development of value-added products to service specific market needs. Further research into this issue would make a useful contribution to the ongoing debate over the future of regulatory marketing agencies in Canada.

Section 11

What is the appropriate role for government?

Governments have a role to play in correcting market failure. The question therefore arises: is there market failure in closely coordinated agri-food sectors, and if so, what is the appropriate role for governments? If one categorizes market failure into externalities (positive and negative), public goods, information asymmetry and monopoly/monopsony power, it is most likely the last three categories in which the market failure question is most relevant.

This section discusses these issues: the role of public versus private R&D as a public good issue, information asymmetry issues, including price discovery and product quality, and the long-standing issue of the existence of monopoly/monopsony power in vertically related markets.

11.1 Public Versus Private R&D

Economic theory predicts an under-investment in R&D activities if private firms cannot reap the full return from their investment. They may not be able to do so due to free rider problems created by the lack of exclusivity and rivalry of the technological advancement. This has long been an argument in favour of public R&D expenditure, e.g., to develop new grain varieties. In the past, once the germplasm was released in the form of seed, the developer of that variety could not prevent his intellectual property rights from being appropriated by others in a subsequent crop year (by saving the seed). Furthermore, the bulk commodity nature of much of agricultural production did not lend itself to branding and product differentiation, so that firms could realize returns from their investments in R&D. In these circumstances, we expect market failure to result in under-investment in R&D.

The biotechnology revolution and the differentiation of food products on the basis of intangible attributes (food safety, process attributes, etc.) has changed this situation in two ways: by motivating the identity preservation, branding and differentiation of agricultural products, and by enabling the protection of intellectual property rights. For example, the ability to switch-off a plant's reproduction capabilities means that farmers must purchase new seed for each crop year. In this way, life-science companies who invest in new crop traits are able to capture the value from this investment to a greater extent than was possible previously. The increase in contracting between seed companies, farmers and grain processors enables those who have invested in the technology to capture the resulting rents. Of course, the advent of Plant Breeders' Rights legislation has also been important in fostering increased private sector R&D expenditure.

The Dutch potato industry provides an interesting illustration of the incentives for R&D which are created by a closely coordinated supply chain. Rademakers and McKnight (1998) describe close cooperation between potato processors and seed potato merchants in the Dutch industry. An important part of this relationship is the processors' investment in R&D into new seed potato varieties to suit the needs of specific markets serviced by the proces-

sor. This investment gives the processors a competitive advantage over their rivals. The contractual relationships between seed potato merchant, farmer and potato processor enable the processor to capture the rents from their investment in R&D. This close cooperation is one of the reasons behind the exporting success of the Dutch industry.

Recent technological developments may enable firms to realize returns from their investments in R&D in a manner not previously possible. For this reason it may be important to reevaluate public and private sector roles in R&D. Due to the uneven nature of technological change, this reevaluation should focus on individual industries.

11.2 Dealing With Information Asymmetry

Market failure due to information asymmetry may impede the formation of closely coordinated supply chains, thereby reducing the international competitiveness of the Canadian agri-food sector. Government policy could reduce or eliminate information asymmetry, e.g., in the provision of information about quality, the accreditation of quality assurance schemes, and of the provision of advice to producers about different supply chain alternatives.

A key issue in closely coordinated vertical markets is price discovery. The public price reporting role traditionally performed by governments is both less important and less feasible in a closely coordinated system in which average prices are not relevant and price information is not readily available to public agencies. The argument that average prices are no longer a relevant indicator of efficiency or a relevant guide to production and investment decisions assumes that, in a closely coordinated system, products will be highly differentiated. Since quality is not average, then average prices cannot be used to describe that quality. For a producer, evaluating whether a fair market price is being offered, depends on the quality produced. Similarly, for processors, the price offered a producer depends on the quality attributes of the differentiated product. Both parties face information costs in setting/evaluating the price. If these transaction costs are sufficiently high, the transaction may not occur and market failure results. There may be a role for a third party in providing an independent, objective assessment of the quality attributes of the product to reduce information costs for producers and processors, thereby facilitating the development of closely coordinated supply chains.

In a sense, by the existing public grading schemes for agricultural commodities play this role. While existing grading schemes reduce information and negotiation costs, by and large, they are based on broad, easily measurable, commodity attributes. Reducing information asymmetry in a sector with highly differentiated agri-food products, will require the provision of far more detailed information on relative quality attributes (including intangible attributes) than those typically measured in traditional commodity grading schemes. Thus, although the principle is similar, the application is likely more complicated.

Technological advances may reduce measurement costs by enabling firms and/or government representatives to measure quality attributes more accurately. In some cases, experience and credence attributes are important to end-users but cannot be evaluated by visual inspection or testing prior to purchase. Experience attributes are detectable after purchase and consumption, whereas the quality, or even presence, of credence attributes cannot be determined even after consumption and purchase. Very often these are "process attributes," such as whether the product was produced in an environmentally friendly manner, or to certain animal welfare standards, or the presence or absence of GMOs in a product. Technological developments may transform experience and credence attributes into search attributes (e.g., the ability to detect the presence of GMOs in a processed product or the texture, taste and palatability of meat products. Others will remain credence attributes (e.g., whether the meat originates from animals reared in welfare-friendly production systems).

There are two roles for a third party, such as the government, in reducing information asymmetry. The first is the support of R&D into technologies which reduce quality measurement costs for experience and credence attributes. A second role is in verifying private sector supply chain audits to assure the presence (or absence) of credence attributes. In other words, if these attributes cannot be evaluated through measurement, their presence or absence can be assured through close control and coordination over the supply chain. For example, suppose retailer A provides a guarantee to consumers that the pork chops it sells were produced using environmentally friendly and/or animal welfare friendly production practices. Consumers wishing to purchase pork chops with this attribute will use this assurance in evaluating the quality of the product. There may be a role for the public sector in verifying that Retailer A has sufficient supply chain audits in place to validate this assurance. Alternatively, this role could be played by an independent private sector third party. Some quality assurance schemes feature verification or audits by independent private firms.

What, then, is the appropriate role for government? At what stage should verification of quality information or supply chain audits be the purview of government or be a function which can be performed by an independent third party private sector player? This is a difficult question. Fundamentally, economic theory suggests that governments should become involved when markets fail to allocate resources efficiently. With the revolution in information technology and advancements in measurement technology, markets in information provision and accreditation have become a reality. The public sector may continue to have a role in establishing licensing procedures, establishing industry standards for the provision of information and accreditation, and facilitating the development of industry-wide quality assurance schemes. The result may be a common set of industry standards to improve and verify quality. Information asymmetry is reduced to the extent that downstream buyers can be assured that a base-level of quality has been achieved by all products receiving the industry-wide quality assurance mark. However, additional quality requirements specific to that buyer would still result in some information asymmetry, providing a motivation for closer vertical coordination to control or detect additional quality attributes.

The changing nature of vertical coordination has altered the information, negotiation, monitoring and enforcement costs facing producers who must find an appropriate buyer and evaluate supply chain alternatives. By contrast, in the past, marketing a traditional agricultural commodity was fairly straightforward. The producer hauled the grain to the local elevator, where it was graded according to a recognized grading scheme, then shipped to market as a bulk commodity. The producer hauled a truck load of cattle to the local packer, or perhaps could choose between a number of local packers depending on the prices they were offering at the time.

Consider instead the scenario in a closely coordinated sector, in which the producer must decide which vertically-linked supply chain to join. Perhaps this involves a five or ten year contractual commitment, with specific obligations on the part of the producer about the quantity, quality and timing of deliveries. Payment might be based on a combination of product quality attributes, the quantity or quality targets achieved by the producer relative to other producers in a "tournament," and/or as a residual of the market return for the final processed product. Access to the market (participation in the supply chain) may require investment in specific assets. The producer may have to follow proscribed cultivation or feeding methods, with detailed documentation and on-farm audits as an integral part of the relationship. Periodic consultations with and/or inspection by downstream partners may be involved. The producer's ability to improve net farm income by changing the input mix may be constrained by contractual obligations with respect to input use or choice of input supplier. This situation requires a very different set of skills for producers: including contract evaluation and negotiation, and management skills where the producer's autonomy to make decisions is restricted but where the producer has access to more information about consumer and downstream buyer requirements.

How does this provide a new role for public policy? There is a need for education and advice to assist producers in obtaining the skills necessary to evaluate different contractual alternatives—where the risks lie, how performance will be assessed, etc. Alternatively, this role could be performed by industry associations or producer commodity groups.

11.3 Dealing with Monopoly/Monopsony Power

In many cases, closer vertical coordination of the agri-food sector has been accompanied by rationalization and increasing concentration in the input supply, processing and retailing/distribution sectors. Monopsony or oligopsony power in downstream sectors and monopoly or oligopoly power in input supply sectors puts producers at a relative bargaining disadvantage. This disadvantage results in the well-known economic outcomes of an inefficient allocation of resources and a loss in social welfare. As discussed in Section 10, this issue is long standing in agricultural markets. It was one of the reasons behind the establishment of the Canadian prairie Wheat Pools early in the twentieth century, to provide countervailing power to producers facing geographical monopsonies in grain handling and transportation. Recently, however, concentration has increased in other sectors—meat packing and processing, the seed industry, genetics, agricultural chemicals, etc.—due to a host of factors, including changing technology and the globalization of markets. Supply chains consisting of vertically related oligopolies have emerged—e.g., hog packing and processing firms vertically related to hog genetics firms and feed mills, either through ownership, strategic alliances or contractual relationships. This presents a challenge for governments in ensuring that a competitive environment is maintained and the social welfare losses and misallocation of resources which result from an abuse of market power are avoided. Competition and anti-trust regulations have a pivotal role to play, which is by no means an easy role, given the absence of market price information in a vertically-linked system. Transfer prices between vertical stages will likely be proprietary information. The role of independent farm producers in this

system and the impacts on consumers in terms of prices and product availability are relevant policy considerations.

In applying competition regulations to agri-food markets, however, a balanced approach should also consider the potential efficiency gains from a more closely coordinated system. Williamson (1985) discusses the evolution of anti-trust law over the past forty years. He states that in the past anti-trust (competition) law was based on the concept of the firm as a production function, with the corresponding idea that the efficient boundaries of the firm were determined by technology. The emphasis of anti-trust investigations was whether or not entry was possible, neglecting benefits from possible gains in efficiency. Nonstandard methods of contracting were considered to be anti-competitive, as true economies were assumed to take a technological form. Williamson discusses how the acceptance of transaction cost economics moved the focus of the analysis to the transactions the firm undertakes, with an understanding of how organizational variety arises to minimize transaction costs. He concludes that the greater understanding of the firm as a governance structure increased tolerance of nonstandard, or unfamiliar, business practices that departed from autonomous market contracting. In addition, a greater appreciation of the efficiency gains from other forms of organization has led to a more balanced appraisal of the public interest in the evaluation of anti-trust cases.

Collective bargaining may be another vehicle to use to address potential monopsony or oligopsony power.[14] Further research needs to address three questions: the conditions under which collective bargaining is appropriate, who would undertake it, and current institutional and legislative obstacles to collective bargaining.

11.4 Regulatory Incentives

In the past, governments have exerted direct control over some facets of the agri-food sector, e.g., commodity price support policies, regulated transportation rates, etc. Recently, policy has become less interventionist and more indirect partly because of a change in philosophy regarding the appropriate role for government policy, in response to budgetary pressures and as a result of globalization and international trade obligations. This does not mean that there is no role for government policy. On the contrary, there are a number of areas in which government action can mitigate market failure.

Government policy cannot regulate an ideal vertically coordinated agri-food system. In essence, this approach was tried in the centrally planned command economies—an experiment which failed miserably. What government policy can do, however, is create a regulatory environment with the requisite incentives for consumer protection and the reduction of information asymmetry. An example might include an evaluation of the costs and benefits of strengthening and extending product liability laws along the entire agri-food chain and/or requiring full traceability of products and their ingredients. Sometimes regulatory requirements in themselves provide the motivation for closer vertical coordination. The 1990 UK Food Safety Act was such a case. It increased the legal liability of downstream firms for the safety of all food which they sold—in effect making them liable for the practices of upstream firms. This liability led to tighter supply chain control and coordination as downstream retailers sought to reduce their risks by auditing the practices of upstream suppliers more closely (Hobbs and Kerr 1992).

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[14] In Section 9.3, see "Collective bargaining and the role of commodity groups."

In other cases, public sector monitoring and enforcement costs can be shifted onto the private sector. If the private sector can provide monitoring and enforcement more efficiently and effectively, then there should be a gain to society. One could argue that this shift has occurred in meat inspection in Canada and the United States. Previously, federal government employees inspected carcasses for food safety hazards using organoleptic techniques (sight, smell, touch) which were insufficient to detect microbial hazards. An alternative method of assuring food safety is to require meat packing plants to follow management procedures which reduce biological, chemical and physical hazards and include microbial testing by the companies themselves. This method is the Hazard Analysis, Critical Control Points (HACCP) system which the US government has mandated for all US meat and poultry and seafood processing plants and which is recommended by the Canadian government. Properly applied, a HACCP system—combined with microbial testing of samples—should be a more effective method of delivering safe food to consumers than the previous public visual inspection system. Although HACCP is not currently mandatory in Canadian meat packing plants, it has been widely adopted because of the importance of the US export market and because downstream further processors or retailers have made it a requirement of their suppliers.

With respect to contract agriculture, different levels of government affect the regulation of contracts and relations between producers and processors. Issues include producers' rights to organize, and requirements to increase the transparency and adequacy of contracts. It is important to raise the question of the most productive venue for these actions. If large regulatory discrepancies exist between provinces or between states, companies may have an incentive to change location. This same concern exists in terms of discrepancies in the laws governing producer-processor relations between Canada and the United States. Laws and regulations could affect the competitive advantage of firms so that they would be motivated to change location. While it is beyond the scope of this report to assess the costs and benefits of a harmonized system of laws and regulations on producer-processor contracts, efforts to tackle these public policy concerns in a proactive manner should be considered.

Section 12

Looking into the future

A look at developments in the economy beyond agriculture is instructive in thinking about the possible future evolution of agriculture. Electronic communication is having a profound influence—both on the way in which business is being conducted and on the way in which human relations are developed. The power of the Internet was demonstrated in Seattle in November 1999, as it was used to organize massive protests over a new round of world trade negotiations. Are there lessons to be learned for the future of agricultural business transactions from the impact of electronic communication in other sectors?

One consequence of electronic communication may be the "deconstruction of value chains." In this context, the term "value chain" is narrowly defined as all of the activities a company undertakes to design, produce, market, deliver and support its product. These activities consist of both a succession of physical activities and the flow of information within a company and between its suppliers, distributors, and customers:[15]

> *"Supplier relationships, brand identity, process coordination, customer loyalty, and switching costs all depend on various types of information… brands, after all, are nothing but the information, real or imagined, intellectual or emotional – that consumers have in their heads about a product. And the tools used to build brands – advertising, promotion, and even shelf space – are themselves information or ways of delivering information." (Evans and Wurster 1999, p. 5)*

Due to its importance, information, and how it is delivered, is a key factor in determining corporate structure. However, Evans and Wurster argue that information is so deeply embedded in the physical vertical coordination process (whether within a vertically integrated firm or between separate firms) that its separate role is largely unrecognized. The power of electronic communication will clarify the role of information as firms begin to deconstruct their internal "value chain."

Evans and Wurster provide a vision of this deconstruction for newspapers, which are currently vertically integrated across an array of journalism, editorial, production and distribution functions. They predict that with the availability to consumers of affordable hand-held electronic reading devices, consumers will be freed of the need to subscribe to an entire newspaper—instead they will download news and other components of newspapers, such as want-ads, from a number of sources. This selection will result in the segmentation of different components of a newspaper into separate business entities. Retail banking is assessed as ripe for a similar upheaval.

Obviously in primary agricultural production, physical processes are an important component of the supply chain. However, as previously discussed, information is also playing an increasingly important role and is an important determinant of consumer demand. Evans and Wurster (1999) advise businesses to evaluate the role of information in the supply chain. We predict that firms which are currently vertically integrated across several business functions will be fragmented into multiple businesses, each with its own comparative advantage. Currently, individual functions may have their own economy of scale or scope, which is compromised when activities are bundled together into one business. As businesses are fragmented, individual functions (physical processes and information) will each be able to reach an optimal size. In many businesses today the physical (internal) "value chain" is compromised by a need to deliver information just as the information value chain may be compromised by physical processes.

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[15] This is distinct from the notion of a "value chain" sometimes used in the Supply Chain Management literature, to mean a series of strategic alliances between successive firms in a vertically related "value chain."

Other possible developments are that monopolies will lose the market power they currently hold based on the ability to control information. Market power often comes from controlling a choke point in information channels. As search and information costs decline, consumers will be able to switch brands more easily, requiring companies to find new ways to generate consumer loyalty. This, of course, assumes relatively free access to information. However, in the agri-food sector, large food retailers increasingly control valuable information about consumers through the use of bar-code technology and store loyalty cards. This control helps them maintain their dominant market positions and bargaining strengths vis-à-vis food manufacturers.

In another look at the future, Malone and Laubacher (1999) continue to develop implications of the "deconstruction of the value chain"—i.e., the simplification and individualization of vertical linkages between consumers and businesses. They argue that electronic networks may lead to a new economy that is centred on the individual who will be able to connect easily with businesses to buy and sell goods:

> *"Such new coordination technologies as powerful personal computers and broad electronic networks enable us to return to the preindustrial model of tiny autonomous businesses conducting transactions with one another in the market. The one critical difference is that electronic networks allow small companies to tap into the global reservoirs of information, expertise, and financing that used to be available only to large companies." (Margretta 1999, p. xvi)*

These visions of future ways of doing business "buck the trend" toward closely coordinated supply chains consisting of vertically related producers, processors and retailers. They have implications for the three categories of agricultural producers discussed in Section 9. Smaller producers of differentiated goods have a better chance of surviving in an economy where information and search costs are low, and producers can deliver specialty goods directly to the end user, whether a processing plant or a consumer. The growth of Internet navigating businesses (comparable to electronic consumer reports) is expected to facilitate direct relations between firms and consumers. Contract producers may not be locked into one supply chain, but may be able to be a member of several supply chains over time, or even simultaneously. A key point is the power that electronic communication will give to producers through increased access to information. This access will be instrumental in the ability of producers to deal with many of the issues raised in Section 9 on contracting, including collective bargaining. The competencies/capabilities approach would suggest that this access to information alters the skills and knowledge relationships between producers, processors and retailers, enabling producers to extend their core competencies into the realm of direct relationships with consumers. To some extent, this flies in the face of generally accepted notions of the changing nature of vertical coordination which sees a reduced role for independent producers; however, it is an intriguing possibility and deserves further investigation.

Thus, looking into the future, advances in electronic communication will present opportunities for producers of specialty goods to deliver directly to the end-user. There will likely be a "first-mover" advantage to those producers initially able to manage the information available through electronic communications and able to find innovative ways to use it. As with any business opportunity, it will be the entrepreneurial producers with the requisite business management skills and acumen who will succeed in this endeavour.

Conclusions and suggestions for future research

At the same time that the rapid changes discussed in this report present challenges to producers and other industry stakeholders, they also present many opportunities. The agricultural sector that is emerging promises to be diverse in terms of farm and market organization. Producers may have choices in terms of the niche they fill and how best to realize their comparative advantage.

Agricultural economists need to reevaluate their traditional preference for a particular form of farm and market organization for agriculture. Ronald Coase points out:

> *"Contemplation of an optimal system may provide techniques of analysis that would otherwise been missed, and in certain special cases, it may go far to providing a solution. But in general its influence is more pernicious. It has directed economists' attention away from the main question, which is how alternative arrangements will work in practice. It has led economists to derive conclusions for economic policy from a study of an abstract of a market situation." (Williamson 1985, p. 327)*

Analysis on the actual impacts of increased vertical coordination will continue to be helpful to policy makers.

Vertical linkages in agriculture are evolving dynamically, and new research questions are continually emerging even as we seek to answer existing ones. By design, this report has taken a broad approach to vertical coordination across the agri-food sector. While there has been a fair amount of research focussing on vertical coordination in US agriculture, industry-specific studies of vertical coordination in Canada are few and far between. In the livestock sector in Canada, the Canadian beef and pork sectors would benefit from an in-depth study of these issues. On the grains and oilseeds side, an analysis of the canola and specialty crops sectors would provide a valuable comparison with the Canadian wheat industry. The role of regulated marketing institutions in facilitating or impeding vertical relationships deserves further attention. The conceptual framework presented in this report provides a starting point for analysis. Other fruitful areas for research are issues associated with the increased use of contracts, including potential inadequacies of current contracts and the need for producer education in evaluating contracts. The potential use of collective bargaining by producers raises a host of research questions.

The lack of basic data describing the nature of vertical relations, including the extent of contracting, in Canadian agriculture seriously impedes the ability of policy makers, industry stakeholders and researchers to monitor and evaluate developments in the sector. The collection and analysis of primary data on the nature of vertical linkages in the Canadian agri-food sector should be a priority for the federal government.

The analysis presented in this report, and the conclusions we have drawn, are far from definitive. They are intended to suggest that, in upcoming years, producers, downstream processors and retailers, academics, and policy makers will need continually to reshape their thinking about the organization of agricultural supply chains and associated policy issues.

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